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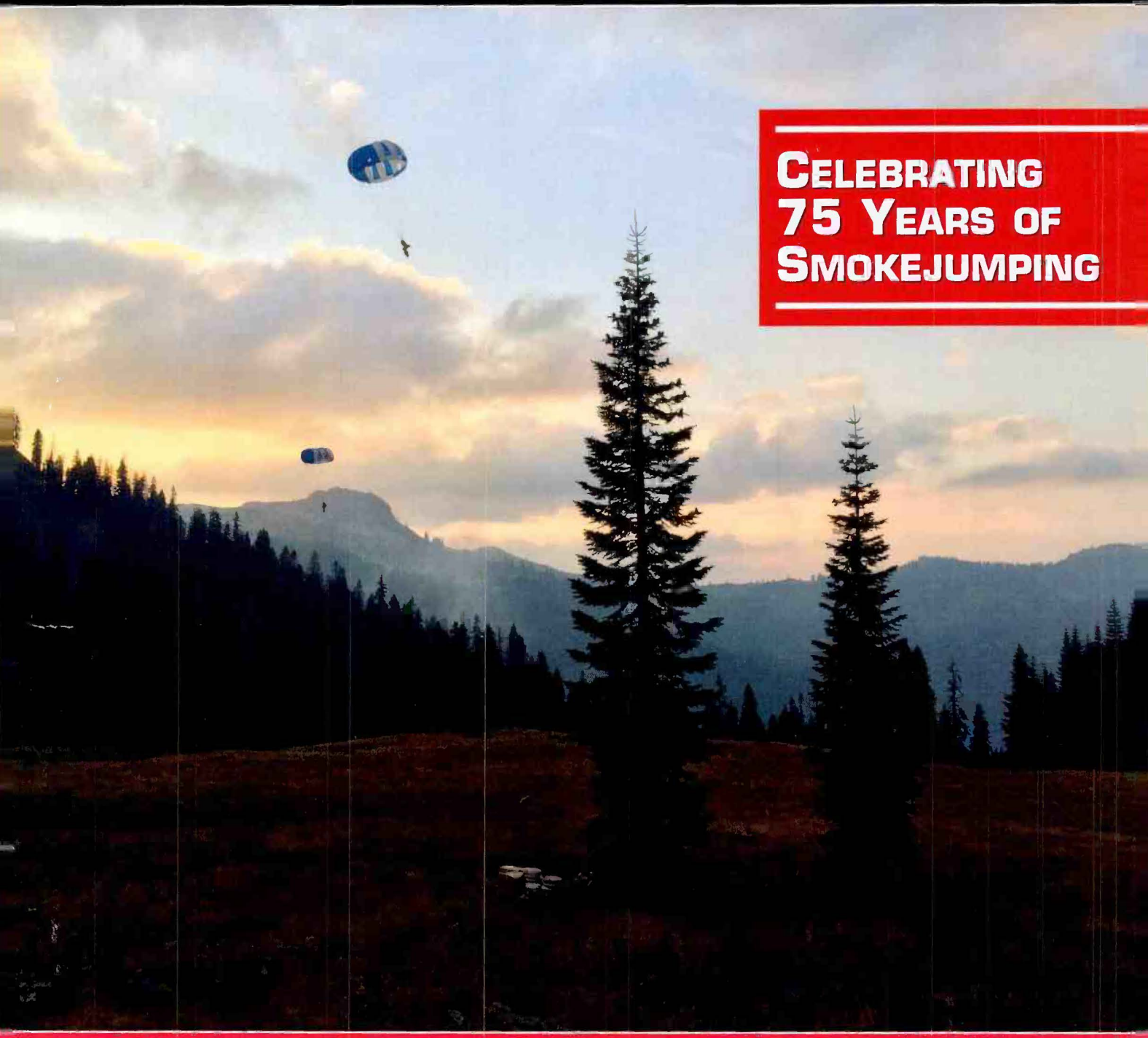

Celebrating 75 Years of Smokejumping

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On the Cover:

Rick Rataj and Don Graham, of the Redding Smokejumpers, jumping on one of the August lightning fires on the Klamath during the 2014 fire season. Fry Fire, Marble Mountain Wilderness, Klamath National Forest. *Photo credit: Raleigh James Coppin, lead firefighter, Tahoe Helitack (HT-514).*

The USDA Forest Service's Fire and Aviation Management Staff has adopted a logo reflecting three central principles of wildland fire management:

- *Innovation:* We will respect and value thinking minds, voices, and thoughts of those that challenge the status quo while focusing on the greater good.
- *Execution:* We will do what we say we will do. Achieving program objectives, improving diversity, and accomplishing targets are essential to our credibility.
- *Discipline:* What we do, we will do well. Fiscal, managerial, and operational discipline are at the core of our ability to fulfill our mission.

Firefighter and public safety is our first priority.

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ANCHOR POINT

by Tom Harbour
Director, Fire and Aviation Management
Forest Service

THE SMOKEJUMPER PROGRAM—A PAST RICH IN HISTORY; A PROGRAM REVERED WORLDWIDE

> *"A forest firefighter who parachutes to locations otherwise difficult to reach."*—
> Merriam-Webster

Men and women involved in our smokejumper program meet the Merriam-Webster definition and do so much more work for the wildland fire community in addition to their daily assignments. By parachuting into the most remote areas of the country, self-sufficient firefighters arrive fresh and ready for the strenuous work of fighting fires in rugged terrain.

First proposed in 1934 by T.V. Pearson, the Forest Service Intermountain Regional Forester, as a means to quickly provide initial attack on wildfires, our smokejumper program is rich in history. The smokejumper program began in 1939 as an experiment in the Forest Service Pacific Northwest Region, with the first fire jump made in 1940 on Idaho's Nez Perce National Forest in the Northern Region. Today, smokejumpers are a national resource. They travel across the Nation to provide highly trained, experienced firefighter leadership for quick initial attack on fires in the most remote parts of the Nation. Firefighting tools, food, and water are dropped by parachute to the firefighters after they land near the fire, making them self-sufficient for the first 48 hours.

In this edition of *Fire Management Today,* you will learn more about smokejumper history, what it takes to become a smokejumper, and the program in general. You will discover there are more than 400 dedicated firefighters, both Forest Service and Bureau of Land Management (BLM) employees who have earned the right to be a part of an organization that is held in high esteem and is readily recognized as having some of the most elite wildland firefighters in the world. Not only do these men and women meet stringent physical fitness requirements and have the courage to deploy from moving aircraft to these remote areas, they must make smart decisions with every action they take while understanding the increased complexity of their jobs, just like every other firefighter.

In this edition of Fire Management Today, you will learn more about smokejumper history, what it takes to become a smokejumper, and the program in general.

As fire managers, we are faced with difficult decisions as we review the effectiveness, efficiency, and focus of each program that supports our wildland firefighting mission, and, just like the smokejumpers, we must make smart decisions and understand the ramifications and complexities that come with making those decisions. It is not always easy. In fact, there are times when we find disparities in our missions within the interagency wildland fire community that can lead to differences in opinions. There are times when we must acknowledge those differences and agree to take different paths, as is the case with smokejumper delivery systems.

The smokejumper program has played an integral role in the history of wildland firefighting in America. We celebrate that history and will concentrate on each segment of the profession, adapt and deal with uncertainties encountered, and help to frame an appropriate program for the future grounded in the principles of fire doctrine and risk management. ■

History of Smokejumping

Lincoln Bramwell

This year celebrates the 75th anniversary of the first test of one of fire management's most iconic activities: smokejumping. Whether one counts as the true dawn of the smokejumper the first test jumps conducted in Winthrop, WA, in 1939, or the first live fire jump a year later, we can reflect on the early innovators who pioneered one of the most unique fire and aviation activities in the world.

The successful use of aerial reconnaissance in World War I sparked ideas for its application in civilian fire operations. After the war, Forest Service Chief Henry S. Graves approached the Army Air Corps, and in 1925, joint experiments in aerial fire control began. Lieutenant Nick Mamer and Lieutenant R.T. Freng of the Washington National Guard launched the first aerial fire patrol in Spokane, WA. The first air cargo drop to ground forces on a fire incident took place in 1929.

While spotting fires and delivering cargo by air was widely accepted, parachuting firefighters to the ground still seemed well beyond the realm of rational thought in the early 20th century. Soon, however, events served to push serious consideration to smokechasers jumping into wildfires in the roadless backcountry. A disastrous fire in 1937 involving Civilian Conservation Corps (CCC) enrollees precipitated a review and subsequent restriction of their use in firefighting. Without access to the massive number of enrollees available for fire suppression, the Forest Service began looking for ways to maximize its decreasing number of fire personnel.

> One of the smokejumper program's defining characteristics is its commitment to innovation—a constant refinement of equipment and techniques that hearkens back to the program's earliest days.

In response to the impending loss of CCC enrollees, the Forest Service expanded its Aerial Fire Control Experimental Project that began in the Washington Office in 1935. Between 1936 and 1939, the program focused on delivering cargo and "bombing" fires with water by air. In the summer of 1939, the agency moved the program to the Pacific Northwest Region under Assistant Chief of Fire Control, David P. Godwin, and Lage Wernstedt. They immediately focused on delivering firefighters to incidents via parachute. Godwin claimed inspiration for the experiment originated from observations of German and Russian paratroops deployed in 1936. He established a correspondence with the Russians who had successfully delivered "parachute firemen" onto Russian

Lincoln Bramwell spent 10 years as a wildland firefighter with the Uinta, Pike, and Santa Fe National Forests. He was also a hotshot in the Intermountain Region. Lincoln Bramwell is now the historian for the Forest Service in Washington, DC.

steppe fires. Realizing the potential, Godwin set his sights on developing the means to send American firefighters into fires by parachute.

From his base of operation on the Chelan National Forest in Washington State, Godwin awarded the Eagle Parachute Company a contract to supply the equipment, riggers, consultants, and jumpers, and he oversaw the first experimental jumps in October 1939. Performing test jumps onto an airfield was dangerous in 1939; attempting the same thing in rough, mountain terrain was an even more difficult enterprise. Two jumpers and local firefighters, Francis Lufkin and Glenn Smith, and a professional jumper with Eagle Parachute Company, made the first jump into rough country. The experiments continued and proved successful enough that in 1940 the Forest Service established a permanent base in Winthrop, WA, and another in Missoula, MT.

A momentous year for the smokejumper program is 1940. On July 12th, Rufus Robinson and Earl Cooley made the first successful "live fire" jump on the Nez Perce National Forest. Three days later, Chester Derry, a Missoula smokejumper, jumped to aid an airplane crash on the Bitterroot National Forest. These events exhibit the diverse skill set and adapted use of smokejumpers in the field that became a hallmark of the program.

The early success of the program drew the attention of the military. They sent four U.S. Army officers to study the parachute training camp and techniques in Missoula. Leading the contingent was Major Cary Lee, who applied what his team learned to the Army's first paratrooper training facility at Fort Benning, GA. He later took command of the 101st Airborne Division and trained all American troops for the D-Day invasion of Normandy as Chief of the U.S. Airborne Command.

The smokejumper program grew after the war as veterans returning home with airborne experience replaced most of the civilian public service smokejumpers. By 1945, the agency maintained bases in Missoula, MT, McCall, ID, Cave Junction, OR, and Winthrop, WA. The Forest Service was so confident in the program's ability it created an air control area known as the Continental Unit that covered 2 million acres in the northern Rockies, was patrolled exclusively by air, and conducted fire suppression.

The decade ended in tragedy when 12 smokejumpers and a fire guard were killed on the Mann Gulch fire in Montana. The incident represents the largest loss of life in the program's history and was later memorialized in Norman Maclean's best-selling book *Young Men and Fire*.

The smokejumper program proved resilient despite the tragedy. During the next two decades, the number of bases expanded and the U.S. Department of the Interior, Bureau of Land Management (BLM) began employing smokejumpers. The program added bases in West Yellowstone, ID, Boise, ID, and Redding, CA along with sub, or "booster" bases in Grangeville, ID, Idaho City, ID, and Silver City, NM. In 1959, BLM established a base at Fairbanks, AK, which served as the

Smokejumping in World War II

World War II's draft of able-bodied men depleted the human resources available for the smokejumper program. Despite its successful birth in 1939, and enthusiastic adoption by the Forest Service, only five experienced jumpers reported for duty in 1942. To supplement their numbers, the Forest Service turned to the Civilian Public Service (CPS), made up primarily of conscientious objectors, to keep the program operational. Hundreds of CPS jumpers served during the war, and, to bolster their efforts, the agency built two more permanent bases in McCall, ID, and Cave Junction, OR in 1943. That year, the CPS jumped 47 fires with an estimated savings of $75,000 in fire costs. The following year, more than 100 fires were jumped. In 1945, the number of jumpers increased to 235 with 1,236 jumps completed on 296 fires for an estimated savings of $350,000.

Later in the war, with the threat of Japanese incendiary bombs tied to high altitude balloons designed to ride the Jetstream to the west coast, the CPS jumper numbers were supplemented by the paratroopers from the 555th Battalion (also known as the Triple Nickles), an African-American unit that completed several jumps. Their unit suffered the first smokejumper fatality in 1945, when Private First Class, Malvin Brown, was killed while trying to extricate himself from a tree he landed in during a fire jump.

Francis Lufkin, 1939. Lufkin was one of five Forest Service personnel to make jumps during the 1939 experimental program. He continued his career as a smokejumper and base manager at Winthrop, WA, until his retirement in 1972 after 33 years as a smokejumper.

core of the State's fire operation. In 1969, the jump base in Boise transitioned into the Boise Interagency Fire Center (now the National Interagency Fire Center); it serves as a regional supply depot, airbase, and management coordination center. The number of smokejumpers nationally peaked at 446 in 1970. In 1981, female smokejumpers broke into the ranks and earned their jump wings.

One of the smokejumper program's defining characteristics is its commitment to innovation— a constant refinement of equipment and techniques that hearkens back to the program's earliest days. In 1985, BLM smokejumpers unveiled one of the program's most recognizable advances. After 5 years of development, BLM jumpers in Alaska overhauled the traditional round parachute in favor of a rectangular chute design popular with sport parachutists. The rectangular design acts as a fabric wing that "rams" air into its nose, allowing the operator to control the speed and direction of the descent. With forward air speed up to 25 miles per hour (40 kilometers per hour), smokejumpers using the ram-air design could deploy to fires with overhead wind speeds that were previously too dangerous to jump with round chutes.

Carrying on in the tradition of Chester Derry, who made the first rescue jump, today's smokejumpers strive to provide a diverse set of crew, single resource, and overhead capabilities to meet multiple needs beyond initial attack. Smokejumpers are emblematic of today's diverse fire and aviation mission. Looking back at their history reminds us of the program's bravery and commitment to excellence inaugurated by that group of air pioneers 75 years ago.

For more on smokejumper history see:

Aviation and Fire Management. 1980. History of smokejumping. R1-80-22. Missoula, MT: Northern Region, Forest Service.

Godwin, D.P. 1939. Smoke jumping. American Forests. 45: 590–592.

Mauck, R. 1985. BLM smokejumpers develop new parachute. Fire Management Notes: 46(2): 26–29.

Pyne, S.J. 1997. Fire in America: A cultural history of wildland and rural fire. Seattle: University of Washington Press.

What Does It Take To Become a Smokejumper?

Daniel Cottrell

What does it take to become a smokejumper is a question that smokejumpers across the country are regularly asked, but the answer is not simple. Each year, there are hundreds of applicants seeking to become smokejumpers. On the most basic level, applicants must meet the minimum qualifications: 1 year of general work experience and 1 year of specialized experience in the field of wildland firefighting. They must also complete the 45-pound (20 kg) pack test and a more rigorous physical fitness test including pull-ups, push-ups, and a 1.5-mile (2.4-km) timed run that smokejumpers either look forward to or dread. Smokejumper positions are extremely competitive, and successful applicants generally have far more experience, qualifications, and fitness levels than the minimum requirements. As legend has it, one aspiring applicant even camped out for days on the lawn of the Missoula, MT, base until he was offered a rookie smokejumper slot.

Smokejumpers come from all over the country and represent a diverse and well-educated workforce. A recent headcount poll of all the smokejumper bases indicates that approximately 10 percent of current smokejumpers are women. Smokejumpers have been teachers, lawyers, accountants, mountain men, navy seals, and even a smokejumping grandmother. More common work backgrounds include all branches of the firefighter community. Most of the smokejumpers worked on hotshot, helitack, district, or forest crews before they became smokejumpers. Many of them served in the military before joining the Forest Service or the U.S. Department of the Interior, Bureau of Land Management (BLM).

Daniel Cottrell is the assistant projects foreman with the Forest Service's smokejumper base in Missoula, MT.

Smokejumpers come from all over the country and represent a very diverse and well-educated workforce.

Smokejumpers are highly motivated and enjoy working outdoors. They also share a strong work ethic, a high level of physical fitness, and a passion to protect and restore public lands. Once accepted, smokejumper applicants must complete a 5-week rookie training program, which takes place every spring. This program is both mentally and physically challenging, and it prepares rookie candidates for the rigors of firefighting. The program also demonstrates how to safely exit an aircraft and parachute into steep and rugged terrain.

Due to its many challenges, about 30 percent of rookie candidates fail to complete the program. If you are interested in being a smokejumper, you should begin a comprehensive physical training program immediately. The following are the minimum physical and educational requirements to become a smokejumper:

Smokejumper Employment Requirements and Qualifications

The physical training test is administered on the first day of rookie training. The Office of Personnel Management (OPM) Physical Fitness Standards for smokejumpers are as follows:

- Run 1.5 miles (2.4 km) in 11:00 minutes or less
- Complete 7 pull-ups
- Complete 25 push-ups
- Pack 110 pounds (50 kg) on level terrain, 3 miles (4.8 km) in 90 minutes or less

There is a maximum of 5 minutes of rest between exercises.

In addition to the OPM Standards, the BLM Smokejumpers have established their own guidelines:*

- Run 1.5 miles (2.4 km) in 9:30 minutes or run 3 miles (4.8 km) in 22:30 minutes or less
- Complete 10 pull-ups
- Perform 60 sit-ups
- Complete 35 pushups
- Pack 110 pounds (50 kg) on level terrain for 3 miles (4.8 km) in 90 minutes or less

* With regard to physical standards and qualifications for continued employment, guidelines do not hold the same legal status as standards. Rookie smokejumpers can only legally be held to the National Smokejumper Physical Fitness standards as adopted by OPM. That said, the BLM Smokejumpers were not arbitrary in the establishment of their guidelines.

Rookie candidates are expected to have basic firefighting skills and working knowledge of fireline tactics before they are hired. Previous parachute training is neither required nor advantageous. If you lack the required fire experience, you may want to consider applying for a position on an interagency hotshot crew, fuels crew, district helicopter, or engine crew. These crews receive valuable experience in fire suppression work, and there are numerous crews located throughout the United States with the majority being in the West. For specific information, contact your local Job Service, BLM, or Forest Service office. You can also browse for seasonal jobs online at: <http://www.usajobs.opm.gov.>

Minimum Qualifications:

- Age: Must be at least 18 years old.
- Height: Must not be more than 77 inches (196 cm) or less than 60 inches (168 cm) tall without shoes.
- Weight: Must weigh at least 120 pounds (54 kg) but no more than 200 pounds (91 kg) without clothes.

Did you know?

Becoming a smokejumper is a highly competitive process. Each year, between 60 and 80 rookie smokejumpers are hired nationally by the BLM and Forest Service. The McCall Smokejumper Base alone receives almost 200 applications a year for 8 to 10 spots.

- Hearing: Must not have acute or chronic disease of the external, middle, or inner ear. Using an audiometer for measurement, there should be no loss of 25 or more decibels in each ear at the speech frequency range. A hearing aid is not permitted.
- Vision: Must be free from acute or chronic eye disease. Corrected distant vision must test at least 20/20 (Snellen) in one eye and at least 20/30 (Snellen) in the other. Individuals must be able to read printed material the size of standard typewritten characters. Glasses or contacts used for eye correction are permitted.
- 12 months of specialized experience equivalent to the GS-04 level duties: OR
  - A 4-year course of study above high school leading to a bachelor's degree with either: (1) a major study in forestry, range management, or agriculture, OR (2) a major in a subject-matter field directly related to the position; OR
  - At least 24 semester hours in any combination of the following courses: forestry, agriculture, crop or plant science, range management, watershed management, soil science, natural resources (except marine biology and oceanography), outdoor recreation management, civil or forest engineering, or wildland fire science. No more than 6 semester hours of mathematics is creditable; OR
  - A combination of education and experience that is directly related to the work of the position.

The OPM Qualification Standards Handbook (which lists the qualifications for this position and all other U.S. Government positions and series) can be found online at: <http://www.opm.gov/qualifications/index.htm.> ■

2016 Events

SMOKEJUMPER EVENTS

Bob Kersh Smokejumper Loft Dedication | Redding, CA | January 14, 2016 @ 11:00 a.m. PST | Contact: Scott Warner at 530-515-1702 (swar@jps.net) | http://smokejumpers.com/index.php/events/getall

Boise Smokejumper 30-Year Reunion | Boise, ID |May 27–29, 2016 | Contact: Todd Jinkins (tjinkins@yahoo.com) | http://smokejumpers.com/index.php/events/getall

Cave Junction Reunion | Cave Junction, OR | Jun 24–26, 2016 | Contact: Chuck Sheley (cnkgsheley@earthlink.net) | http://smokejumpers.com/index.php/events/getall

GENERAL FIRE MANAGEMENT CONFERENCES

Wildland-Urban Interface Conference 2016 | Peppermill Resort, Reno, NV | March 8–10, 2016 | http://www.iafc.org/micrositeWUI/homeWUI.cfm?ItemNumber=7987

5th International Fire Behavior and Fuels Conference |Portland, OR, an Melbourne, Australia | April 11–15, 2016 | http://www.firebehaviorandfuelsconference.com/

International Conference on Forest Fires and Wildland-Urban Interface Fires | Aix-en-Provence, France | May 25–27, 2016 | http://forestfire.irstea.fr/

Beyond Hazardous Fuels: Managing Fire for Social, Economic, and Ecological Benefits | Loews Ventana Canyon Resort, Tucson, AZ | November 28–December 2, 2016 | Organized by AFE and Southwest Fire Science Consortium | http://swfireconsortium.org/wp-content/uploads/2015/07/Save_the_date_flyer.pdf

7th International Fire Ecology and Management Congress | Orlando, FL | November 2017 | http://fireecology.org/upcoming-conferences

First Jump

Kyle Goldammer

"First load to the box." Calmly, but with urgency, these words rolled through the intercom while I was in the loft working on a project for the afternoon. As the alarm sounded through the building, I knew that meant we had a fire call, and without hesitation, I dropped everything and sprinted to the suit-up racks. I had my gear meticulously hung on the rack and began to suit up as fast as I could, knowing I had 2 minutes to be on the jump ship, ready to roll. With my heart pounding, I hurried and grabbed everything I could think of needing; it was possible that I could be gone for a couple weeks. On my way out the door, a couple of my rookie brothers were there to send me off with a high-five and a "have a good jump!"

Walking out on the tarmac, my personal gear (PG) bag in one hand and helmet and gloves in the other, the smell of fuel and the wind from the engines rushed over me and got stronger as I made my way towards Jump 17. I climbed into the back of the aircraft, what we call the "CASA," got to my seat, and buckled myself and my gear in. We taxied out to the runway, and less than 6 minutes from when the siren started wailing, we were in the air and on our way to a fire.

A few minutes into the flight, I was handed a map and other fire information, which I then passed down to the jumper-in-charge. We all knew by then that we were headed to a fire near the Arctic Circle and had a little flight time before we reached our destination. Soon after, everybody sunk into their respective area and tried to get a little bit of rest before the long shift ahead of us. Riddled with excitement and adrenaline, I shut my eyes, but knew I was not going to get any sleep.

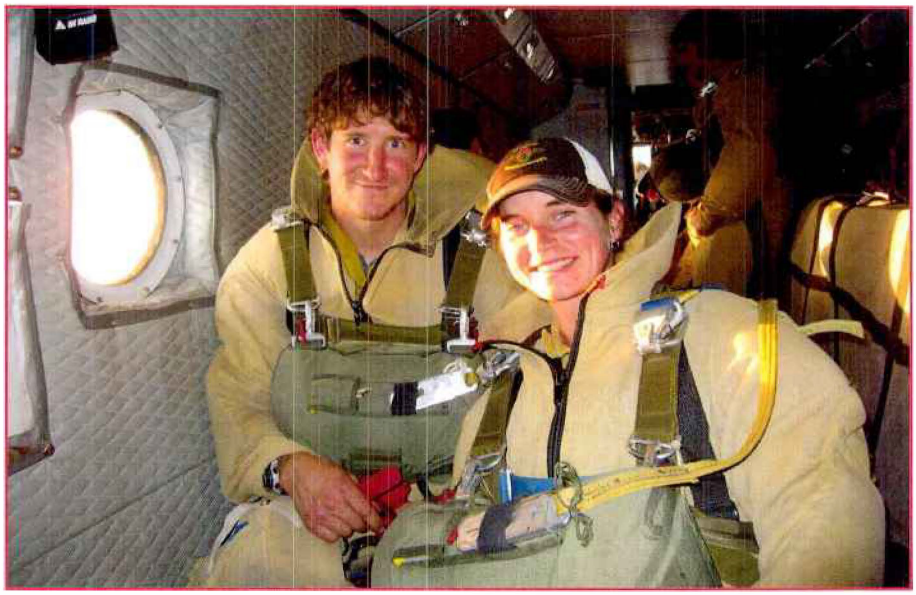


Photo provided by Kyle Goldammer.

I had never been to Alaska, and there I was gazing down at fire #230; the terrain looked like a different world to me.

We got the 5-minute call, and everybody started on their pin and secondary equipment check. Peering out of the CASA, I stared out as the column of the fire filled in the small window. "Door coming open, guard your reserve!" the spotter yelled as I covered my reserve handle with my right hand. The cool air barreled in, and the beads of sweat streaming down my forehead evaporated. I was second in the door and had a front-row view of the fire making runs and ripping across the tundra and spruce. I had never been to Alaska, and there I was gazing down at fire #230; the terrain looked like a different world to me.

We circled a couple times, gathering intelligence on the fire and trying to find the best possible jump spot. We decided that we would jump at the heel of the fire and got into place so the spotter could throw the streamers. I watched them sail into the distance and then, not long after, hit the ground. We flew around one more time to throw the check set, and I once again watched the streamers fall into the jump spot. The spotter called out "1,000 yards (914 m) on the streamers" as we climbed

Kyle Goldammer is a smokejumper with the U.S. Department of the Interior, Bureau of Land Management in Alaska. His first jump was on May 31, 2014.

Photo provided by Kyle Goldammer.

to jump altitude. I immediately started thinking about all the ways that I needed to fly my parachute in high wind conditions to get to the ground safely.

"Ready and tight?" my jump partner (JP) asked. "Ready," I yelled. I had been ready for a lot longer than I needed to be, but I wanted to make sure that I was not going to fall behind the curve. We got into place, hooked our static lines up, and got our spotter briefing. Standing next to the door with nothing but open air and 3,000 feet (914 m) to the ground in front of me, this was it. An overwhelming shot of adrenaline surged through my body as we turned and my JP moved into place in the door. I did my four-point check and was dialed in on my next move of getting myself into the door. "Get ready!" the spotter yelled raising his arm and slapping down on my JP's shoulder, his cue to hurl himself into the open air. I waited for the static line to clear and got down into position. As the wind screamed by, cruising at around 100 knots (185 kph), I held my body tight against the plane. I felt the slap on my shoulder and, without any hesitation, I launched myself out of the door as hard as I could. As I plummeted to the earth, I started my jump count and I could see Jump 17 speeding away from me.

When the time came to pull my drogue release handle, my canopy snapped open and just like that, the air felt calm. I found my JP just before he cranked out some bomb turns and slid into the pattern we had talked about while circling the fire. With a heightened sense of awareness and with the rigorous rookie training behind me, I felt confident. Regardless of all the adrenaline and nerves, it all came to me as second nature. I flew my pattern, crabbing and making the right adjustments to get where I wanted to go while maintaining enough space with my JP. I watched him land right in the spot as I slid my canopy into final. Turning into the wind, the cells of the canopy started fluttering as I slowly drifted down into the tundra right next to my JP.

"I'm okay!" I yelled to him, ecstatic with the way the jump went. Full of energy, I hurried to pack up my gear so I could run and fetch cargo as fast as I could to prove to the other jumpers that this is where I wanted to be. As I was packing up, my JP threw me a T-shirt that said "AK SMJ est. 1959" and yelled "Congratulations!" I thought about the few guys who have been in this position and felt grateful to be in the middle of Alaska working on a fire. It was official, I was an Alaska smokejumper. We gathered up and worked up the flanks of the fire. I had an uncontrollable grin from ear to ear all night as we worked into the midnight sun. ■

Terms:

Jump 17: The call sign for one of the four jump ships assigned to Alaska operations.

Throw the check set: A second set of streamers that the spotter throws to confirm the wind drift shown on the initial set of streamers and to confirm that the spotter has the correct exit point for round canopies.

Jump count: A verbal count that the jumper performs to ensure the main canopy is deployed at the correct time. "Jump thousand. Look thousand, Reach thousand, Wait thousand, Pull thousand."

Bomb turns: A parachute turn type executed by pulling a front riser down that results in a high vertical descent rate useful for gaining vertical separation from a jump partner or partners.

Final: The last portion of the parachute flight. Typically, this portion begins at an elevation of 200 feet (61 m) above ground level and ends with the landing.

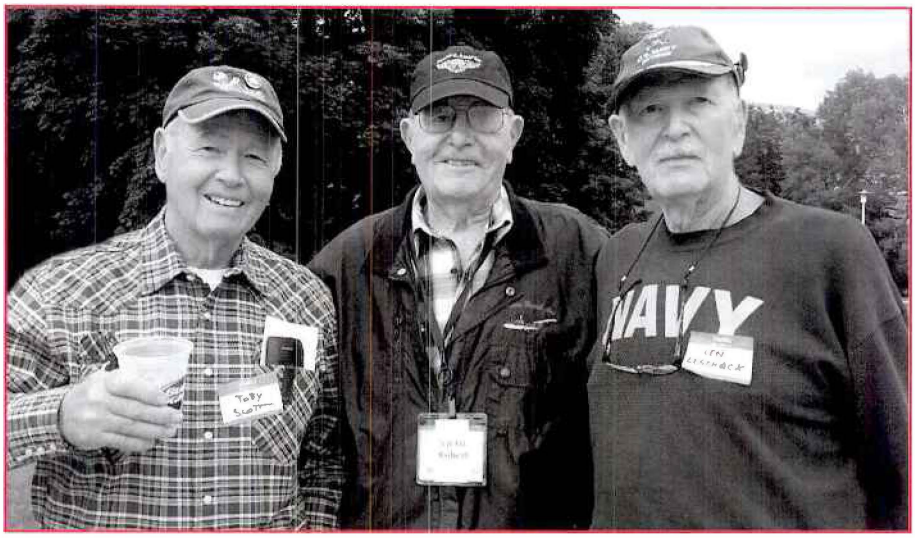
Streamers: The colored and weighted crepe paper that is dropped by the smokejumper spotter to determine wind velocity and any vertical component to the air mass. Crepe paper is approximately 8 inches (20 cm) wide, 20 feet (6 m) long. Blue, red, and yellow are the most commonly used colors. The paper is weighted by sand to duplicate the vertical descent rate of an average size smokejumper on a round canopy.

CASA: Construcciones Aeronauticas SA. Refers to the manufacturer of the primary jump ship type used in Alaska, CASA 212.

Smokejumper Innovation Used In Clandestine Operation*

Chuck Sheley

During a 7-day span in May 1962, the U.S. intelligence community had an extraordinary opportunity to collect intelligence from an abandoned Soviet research station in the Arctic. The effort, "Operation Coldfeet," used an equipped B-17 to pick up two intelligence officers who parachuted to the ice several days earlier. The crew, including former smokejumper Toby Scott (McCall-57) and six other former smokejumpers, collected valuable information, including Soviet research on acoustical systems to detect under-ice U.S. submarines.



Three of the original crew from "Operation Coldfeet" pose for a photo at the 75th Anniversary of Smokejumping Reunion in Missoula, MT, in July 2015. Pictured left to right: Toby Scott, Bob Nicol, and Len Leschak. Photo provided by Chuck Sheley.

In May 1961, the U.S. Navy reported that the Soviets had abandoned one of their "ice stations" when it was assumed that it would be crushed by a pressure ridge and sink into the Arctic Ocean. The abandoned Soviet station was too far into the ice pack to be reached by an icebreaker or helicopter.

Robert Fulton, a talented inventor, had developed a pickup system to retrieve objects from the ground with an airplane. The system involved a nylon line attached to the pickup aircraft that was raised by a helium-filled balloon and caught by "horns" protruding from the nose of the pickup aircraft flying at low level. The pickup was then winched into the flying aircraft; a difficult, dangerous, and skillful operation. After many attempts in 1958, the system took its final shape and was called Skyhook.

The plan was to parachute two military jumpers from a modified B-17, collect data and equipment from the Soviet ice station, and then extract the equipment and men using the Skyhook system. The plan was turned over to Gar Thorsrud (Missoula-46), President of Intermountain Aviation in Marana, AZ.

There were several smokejumpers from Missoula, MT, and McCall, ID, involved in Operation Coldfeet. Those who were involved are aging; in a few more years there may not be anyone who can give a firsthand account of this bit of history. In January 2010, I asked former smokejumper Toby Scott to write down his recollections of this operation. The following is Scott's account of Operation Coldfeet, and the development and use of the Skyhook system:

"When I first started working with the Fulton Skyhook system in February 1962, we were using the B-17G and retrieving dummies through the 'Joe Hole' in the belly. After nearly crashing, when the dummy started making wild erratic circles and wrapping around the tail, we started bringing the dummy in through the tail. This worked out well and proved successful. By April 1962, we had the system working well and would consistently have the pickup on board about 6 minutes after contact. The system was initially used

Chuck Sheley is the editor of "Smokejumper" magazine. He was a smokejumper for 13 seasons and spent a total of 32 years fighting wildland fires with the Forest Service and the U.S Department of the Interior, Bureau of Land Management.

* A portion of this article appeared in the January 2010 issue of *Smokejumper* magazine.

Due to the classified nature of the mission, few, if any, photos exist of the nonmilitary B-17s used in "Operation Coldfeet." While the two figures above depict Naval test aircraft, and not the B-17s to which the CIA would have had access, they illustrate how the Fulton Skyhook mechanism would have been operated. Photo provided by Chuck Sheley.

to pick up a captured American B-26 pilot in Indonesia. Sometime in May 1962, Attorney General Robert Kennedy negotiated the release of the pilot. We were then stuck with a clandestine retrieval system and nothing to do with it until Operation Coldfeet.

The United States and Soviet Union had maintained research and listening stations on the polar ice cap for years. Large cracks had started forming in the ice pack near the Soviet runway in March 1962. They packed up and made a hasty departure. They thought no one could retrieve intelligence from the site in such a short timeframe because the runway would soon be unusable.

The U.S. Navy and the Central Intelligence Agency (CIA) decided this would be an excellent opportunity for the Fulton Skyhook system. We packed up all our gear in the B-17 and a C-46 and headed north.

We stopped in Seattle, WA, and picked up Air Force Major Jim Smith, Lieutenant Leonard Leschack (USNR), and Pan-American Airlines navigator Bill Jordan. Jordan rode in the nose with me, and he knew how to navigate using sun lines. When you are close to the North Pole, a compass is not reliable. There was a periscope in the nose roof through which he could observe the sun to navigate. Leschack was a young man, about 23, who had just completed a hasty jump training course, and Smitty (Smith) was a seasoned airborne veteran about 35 years old. They were well qualified for this project as they were both fluent in Russian.

We flew from Seattle, WA, to Point Barrow, AK, where we landed on a 5,000-foot (1,524-m) runway and stayed at the U.S. Naval Research Station. We wound up making five trips out of Point Barrow that lasted about 12 to 14 hours each. The first time out, we could not find the Soviet ice station, but with the help of a Navy P-2V, we located it the second time out and dropped Smitty and Leschack and all their supplies.

Back then, we did not have all the navigating tools that are available now, so when it came time to pick them up, it took three trips before we located them and the conditions were far from perfect. There was about a 30-mph (48 kph) ground wind and an 800-foot (244 m) ceiling. In the development stage of the Skyhook system when there were high winds, we bounced the dummies off the ground a couple of times. Needless to say, there was great concern for the safety of Smith and Leschack. The weather was going to get worse, so we decided to go ahead with the operation.

Fortunately, we had two capable and experienced pilots—Captain Connie 'Seig' Seigrist, who flew for General Chenault, and Captain Doug Price, who flew a C-119 ('Dollar Nineteen') at Dien Bien Phu. We retrieved the 150 pound (68 kg) intelligence bundle first and then picked up the two men with no problems. Needless to say, this entire operation was at the time highly classified."

Besides Toby Scott and Gar Thorsrud, other former smokejumpers involved in the project were Jack Wall (Missoula-48), Miles Johnson (McCall-53), Jerry Daniels (Missoula-58), and Bob Nicol (Missoula-52).

Years later, the CIA commissioned artist Keith Woodcock to do a series of paintings that would be permanently displayed in the lobby of CIA headquarters at Langley, VA. One of these paintings portrays the B-17 pickup during Operation Coldfeet; it is still on display in Langley. ■

Delivering Supplies From the Skies

Christine Schuldheisz

Smokejumping can be a dangerous and arduous job for the hundreds of Forest Service and U.S. Department of the Interior smokejumpers who make it their career. Their job can be even more challenging without the proper nourishment, equipment, and supplies. Para-cargo drops provide both aid and relief. Para-cargo is a cost-effective and expedient way of delivering large and small payloads to personnel in the field. Para-cargo is an essential part of providing logistical needs to the boots on the ground.

"If it can fit into the plane, we can para-cargo it out," said Jarrod Sayer, air operations foreman for the McCall Smokejumper base in Idaho. "We are capable of providing food, water, pumps, saws, medical gear, fuel, and most items from the warehouse cache."

In addition to the long list of para-cargo supplies, there is an option to drop fresh food to ground personnel. Hand and helitack crews have been receiving fresh food; fresh food is also becoming popular with smokejumpers. The McCall para-cargo program has a standard menu that provides 3 days of fresh food to smokejumpers. "There are pros and cons to any type of nourishment provided on the fire line such as hot buckets, meals ready to eat (MREs), and sack lunches," says Sayer. "But the cost, nutritional value, variety, and crew morale supersedes the time to prepare the fresh food meals."

Christine Schuldheisz is a public affairs specialist with the Forest Service at the National Interagency Fire Center in Boise, ID.

Readying a saw for para cargo: (1) Put saw in box (dawgs down); (2) Fit in a Sigg bottle of oil (bubble wrapped), tool kit, bar with chain, and cover.

In 2013, the McCall para-cargo program dropped more than 900 bundles of standard and special para-cargo totaling 53,000 pounds (2,404 kg) to support fire personnel on the ground on fire incidents.

Safety is a top priority for smokejumpers, and that extends over to the para-cargo program. In the last 20 years, there has not been an incident where an aviation accident occurred during para-cargo operations. "Para-cargo provides a safer alternative to helicopters and/or vehicle support and the word is getting out that it's a viable option," said Sayer.

Early Years

In the early 1940s, transporting supplies to smokejumpers was a bit more difficult due to the lack of

Packaged big wheel.

Clockwise from top left: (1) and (2) double action packer; (3) finished saw box; and (4) burn kit.

technology. Communication from the ground to the aircraft was all done with two pieces of "streamers," known in the Forest Service as the "Visual Signal Code." If a resupply was needed, a plane would have to fly to the incident, look at the two pieces of streamers that were placed on the ground, and decipher what was being requested. For example, the letter "U" would signify more drinking water, and the letter "F" meant food. They would then come back to the smokejumper base and load up whatever equipment the jumpers needed. This was the primary process for resupply via para-cargo until the advent of the two-way radio.

Current Program

In 2013, the McCall para-cargo program dropped more than 900 bundles of standard and special para-cargo totaling 53,000 pounds (2,404 kg) to support fire personnel on the ground on fire incidents. There were a total of 24 para-cargo missions on 12 separate fires; 14 of them were fresh-food missions.

In closing, the para-cargo program is a proven cost-efficient, timely, and safe way to provide meals and supplies to firefighters in the field. Whatever firefighters need on the ground to do their job, they will receive it by air through the para-cargo program. ■

Mechanical Trail Packer Hits the Silk*

A.B. Everts

In the July 1955 issue of Fire Control Notes, District Ranger Parks of the Payette National Forest reported on a "mechanical mule." In a footnote the editor remarked, "At least five other models of this versatile machine are being designed, tested, or produced by private and government agencies." This article reports on one of the commercial models and some of the modifications that have been made to it (figure 1).

There are at least thirty of these machines in use in the region, most of them by trail crews. They are so common that they are no longer a topic of conversation; it is quite probable that we have not heard some of the interesting stories regarding their use. Packing lookouts in and out of their stations is commonplace. Considerable ingenuity has been exercised by various individuals for improving the units for trail use. Stands of various kinds have been devised to hold the loaded packer upright while loading and unloading and during trail stops.

The Wenatchee National Forest has one equipped with a winch which is used to pull out small stumps on a trail construction job. This forest has also recently completed a project in which it modified a packer into a mobile trail-compressor unit. The unit, complete with compressor, drill steel and bits, jackhammer, and accessories, weighs 655 pounds (302 kg), including the weight of the packer.

The Mt. Hood National Forest has used the packer for transporting rolls of paper for covering brush piles in connection with a clear-cut slash-disposal experiment. It was also a Mt. Hood two-person trail crew that made a 70-mile (113 km), 10-day, trail-opening expedition in which all their tools and supplies were transported on a packer.

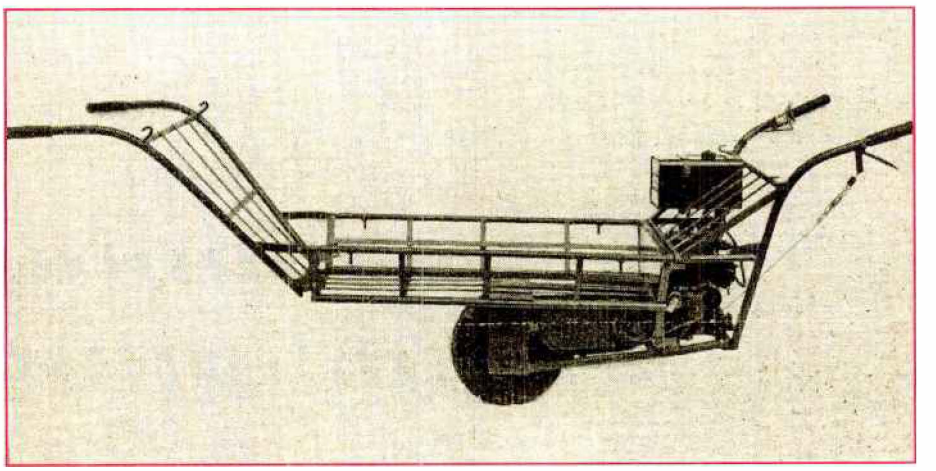


Figure 1.–*This model of the packer weighs 175 pounds and is powered with a 2 1/2-hp, 4-cycle motor. Gasoline consumption is 16 miles to the gallon; two speeds, 5 m.p.h., and 2.5 m.p.h.*

A.B. Everts was an equipment engineer, Division of Fire Control, Pacific Northwest Region, Forest Service.

* This article originally appeared in 1956 *Fire Control Notes* Volume 17, No. 3, 10-13.

The Wallowa-Whitman National Forest has a trail kitchen packer, complete with plywood built-ins, which brings a touch of convenience, if not luxury, to an isolated camp (figure 2).

The manufacturer of the packer has a companion unit called the "trail grader" that gets excellent results on trail construction jobs. This unit has considerable promise as a fireline digger and, while the manufacturer does have some figures on rates of fireline construction, it is not yet ready to release the unit without more field experience. The manufacturer does believe that in many types of fuel, the grader will do the work of 6 to 10 people with hand tools.

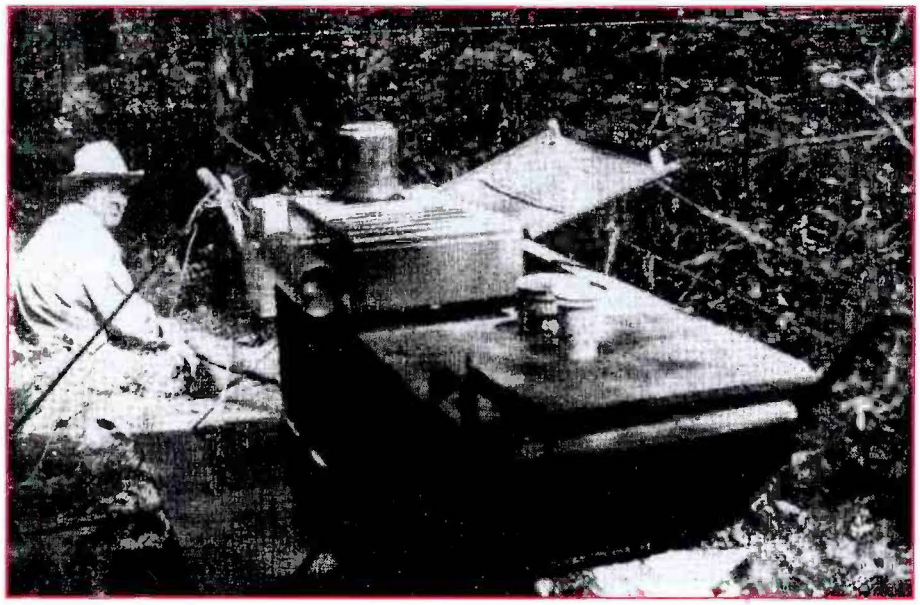


Figure 2.–*The Wallowa-Whitman Forests trail unit with built-in plywood box. Complete unit includes the following equipment: Two axes, one haze hoe, one crosscut saw, one pruning saw, two canteens, three sleeping bags, three knapsacks (personal), a three-person mess kit, one gasoline lantern, one gasoline two-burner stove, one tarp, groceries for three people for 1 week. Approximate load is 300 pounds.*

Figure 3.–*Packer, in two sections, packaged for dropping. Note the padding under the engine on the left-hand section, designed to lessen the landing impact.*

Francis Lufkin, aerial project foreman of the North Cascade Smokejumper Unit, has brought up the idea of using the packer to retrieve smokejumper equipment. Lufkin has demonstrated that his idea is sound. A smokejumper's "come-out" equipment, including his fire tools, which are dropped to him, weighs about 105 pounds (48 kg). This is a sizeable load, even for the young huskies who hit the silk on these back-country fires.

In times past, it was procedure for smokejumpers to backpack their equipment out to the nearest trail, where it would be picked up by a packstring. This still occurs, but in this changing world, packstrings certainly are not increasing in number. Packing is beginning to be spoken of as a lost art. There are still plenty of mules; however, the same cannot be said of packers. The result is that smokejumpers backpack their equipment all the way out on many fires.

Lufkin wants to change this, at least on the long packs, and it looks as though he is going to do it. He made some changes to the packer. He changed the clutch arrangement to contain its own tighteners for easier control. He also added side stands to hold the machine upright while motionless. Finally, he added a crazy wheel in the rear to eliminate the need for fore and aft balancing. Then Lufkin devised a way to break the machine down into two parts; with the accessories, it was too heavy and too awkward to get it out of the aircraft door easily (figure 3).

There was one more important step, training. After successfully completing test drops, a few smokejumpers were trained to assemble the unit, how to start the engine, how to use the clutch, how to tighten the belt, etc. They had confidence in the machine before it ever came drifting down to them "out of the blue," as it did shortly afterward on the Hungry Ridge fires. There were two fires, both started by lightening, a little over a quarter of a mile apart. Four jumpers went down, two to a fire. They got to their fires and mopped them up. Then they loaded their equipment on the packer, 410 pounds (186 kg), and headed out (figure 4).

Figure 4.–*Smokejumpers coming from the Hungry Ridge fire over old sheep driveway.*

The packer has its limitations, but its area of operation is increasing. The Pacific Northwest Region is beginning to talk about better trail maintenance and a different kind of water bar. Fording streams is a problem. Wenatchee National Forest personnel say that, in many crossings, they can solve this by stretching a small cable across the stream. They simply hook the packer to the cable and skyline it across, load and all.

There is no doubt about it; the mechanical trail packer is here to stay. It is not at all improbable that within 5 years, one or two of these units will be standard equipment at many ranger districts; at least on those districts that have an extensive trail system. You will hear repeatedly as you talk to the people who are pioneering their use, "Sure, there's work connected with them. So what! You don't have to round 'em up when you crawl out of the sack in the morning. And you don't have to feed 'em all winter long like you do the long-eared hay burners." ■

Success Stories Wanted!

We'd like to know how your work has been going! Provide us with your success stories within the state fire program or from your individual fire department. Let us know how the State Fire Assistance (SFA), Volunteer Fire Assistance (VFA), the Federal Excess Personal Property (FEPP) program, or the Firefighter Property (FFP) program has benefited your community. Blogs should be between 100–200 words, Articles should be between 500–1,000 words, and Feature Articles should be between 1,500–2,000 words.

Submit your feedback, articles, stories, and photographs by email or traditional mail to:

USDA Forest Service
Fire Management Today

201 14th Street, SW
Washington, DC 20250
Email: firemanagementtoday@fs.fed.us

If you have any questions about your submission, you can contact one of the FMT staff at the email address above.

Then and Now: Reflections of a Retired Smokejumper

Jeff Davis

My career with the Forest Service spanned 28 years, from 1957 through 1984. I remained an active smokejumper for 22 of those years, until I hurt my back on a jump in Montana in 1978. I started with the smokejumpers in Missoula, MT, in June 1957. I worked out of the largest training base for smokejumpers in the country: the Aerial Fire Depot (AFD). Getting a position on the "spike crew" going to the Gila National Forest near Silver City, NM, was considered a "plum." (A "spike crew" is our term for a smokejumper base that did not offer year-round training and was only activated during the fire season.) Because of the large number of fires on the Gila National Forest, smokejumpers from all the bases vied for positions on this 20-person crew.

I put in a heavy pitch for the "plum" as often as I could, beginning in my second season in 1958 when I first qualified for the position. The AFD did not accept first-year rookie smokejumpers for the Gila National Forest because of the intensity of the action and the tough jumping conditions. The rocky, steep terrain, the unpredictable winds, and high-density altitude makes for dangerous parachute jumping in nearly all situations. High-density altitude is the result of a combination of high elevation and hot temperatures. This leads to thin air. Thin air affects parachutes and aircraft alike; the thinner the air, the harder the descent.

Jeff Davis was a smokejumper from 1957 to 1978. He was also an equipment specialist until 1984 with the Forest Service.

The mission was the same back then as it is today. The methods, tools, and rules for accomplishing that mission, however, were different back then than those of today.

I made the 1958 Gila National Forest crew, and, by hook or crook, I also made the next three consecutive seasons in New Mexico. I missed the 1961 season because I was the new squad leader in Montana for a tough fire season there. I returned to the Gila National Forest and jumped from 1962 to 1966. While I was there, I made well over 50 jumps and also had a few on the Cibola National Forest and Apache National Forest. We mainly covered the Gila National Forest, and we were usually only requested for fires in the wilderness area of the forest. Firefighters dispatched in vehicles, on foot, or on horseback could access the roads and the less arduous areas, which cost less than smokejumpers. Helitack was basically unknown in those days, so we covered a lot of the backcountry that is now mostly covered by helicopters.

The mission was the same back then as it is today. The methods, tools, and rules for accomplishing that mission, however, were different back then than those of today.

Physical Training

Tough physical fitness standards were in place then as they are now. We ran 0.5 miles (805 m) for time, but we did not run in sweats or running shoes. We ran it right down the asphalt ramp in work clothes and White's, Western-style logger boots that weigh 6 pounds (3 kg) each.

We were familiar with the obstacle course, too, but we ran it for endurance not for time. The first time I went to the course, I saw a squad leader positioned at each sawdust pit and I wondered why. After three times around the course, I found out why: they used their boots to kick us to our feet as we collapsed into the pits from sheer exhaustion.

Pay

My beginning wage as a smokejumper was less than $5 an hour. As a foreman, I never made more than $9 an hour. It was all straight time, but no time and a half and no hazard pay. We called it straight time, overtime.

Clothing

Nomex was unknown then, so we fought fire in 14-ounce (397 g) cotton denim Levi's or "Can't Bust

'em" Frisco jeans. In my opinion, 14-ounce (397 g) cotton beats 7-ounce (198 g) Nomex every time for protection against heat and fire ash. It proved to work well during direct attacks, right up against the flaming front of those fires. Hardhats were unknown; therefore, we wore the logger's "crusher" felt hats or no hats at all.

Support Equipment

When I started as a smokejumper, we did not have radios. Ground-to-air communication was accomplished by laying out the orange crepe paper signal streamers we carried in our rope pockets, a "double L," signaling that all smokejumpers were down and okay. The first radio I used was in 1958, in New Mexico on the Gila National Forest. It was a huge Motorola, about 12 inches (30 cm) long, weighing several pounds. We jumped with them slung under our reserves. Chainsaws were also unknown; we were all familiar with the two-person crosscut saws, which we called "misery-whips."

We had fire shelters, but we were not required to wear them on the line. We left them with our personal gear, ready to use if we needed them.

We carried our 120-pound (54 kg) loads out on small wooden frames called "clack frames." They often broke during the drop, and we patched them together with fiberglass tape or whatever else we had on hand. Pack-outs were common. The only choppers we had then were G3-B Bells, and there were precious few of them. I remember my longest pack-out being about 23 miles (37 km), but 5 miles (8 km) or so was the norm. Our personal gear bags were small and light in comparison with the 40-pound (18 kg) bags carried by some nowadays. I carried a pair of socks, my "tin coat," and a carton of Lucky Strike cigarettes in mine.

The cost of our gear then was commensurate with the times, when cigarettes cost 25 cents a pack and gas was 25 cents a gallon. My first pair of boots cost $29.95. I thought that was pretty steep, but now they run about $450.

Initial Attack

In those days, we hit the running front of those fires directly, not as they do today where they attack the flanks and gradually work towards the head and pinch it off. Two-person fires were common. A 16-person or 32-person fire was the biggest we ever had; most of them occurred on the Salmon River. I will never forget the dreaded call, "Sixteen men to the Salmon." It ran chills down my spine.

Smokejumper Gear

Our first parachutes were FS-2 canopy-first deployed "candy-striped" 28 footers (9 m). We called them "flat wraps," and they opened with a bang. Many times, we jumped in a haze of stars streaking across our vision. Our harness was the old cotton "H-1," where the four connecting straps joined in a single-point box release at the center of our bodies. A pull of the cotter pin safety and a quarter turn counterclockwise released all four straps at once. I recall one time, upon landing, I gave my release box a crank and found that I had locked it instead of releasing it. It was open all the way down. If I had touched that thing in midair I would have found myself in freefall.

The jumpsuits were more or less the same design then as they are today, but the material was 17-ounce (482 g) canvas duck with 0.25-inch (6 mm) felt padding. My first helmet was leather, sporting the familiar wire mesh mask. Our jump boots were one of two models, no exceptions; the same logger boots used today and a similar boot made by Buffalo. The "Buffs" went extinct after a couple of seasons, and we jumped only in logger boots.

Aircraft

My first jump was out of a Ford tri-motor. The second person out of the Ford was a difficult feat indeed. I usually managed just to get myself out the door, ignoring exit position, and worrying about that on the way down when it was too late.

We also flew in a small fabric and wood job called a Curtis Wright Travelaire for two-person fires.

Our prime carrier, as it was with the airborne, was the DC-3 or C-47. A dependable workhorse until it wore out from lack of replacement parts. We also had a DC-2, the only one I have ever seen. The days of the Twin Otter were still far in the future for me, as were the more sophisticated retardant ships. We relied on the one tanker available at the time, the torpedo bomber medium. It carried a load of 500 gallons (1,893 L), which at that time was borate, a caustic chemical that sterilized soil when it was dropped.

As I look back on those 22 years of smokejumping, it was the finest experience of my life. Smokejumpers watch out for each other, we rescue and protect the injured ones, and we hold the ones that die in our arms. We are brothers, and we do not leave anyone behind. Those were the best years, the best of times. ■

Traditions Live on in the National Technology and Development Program

Mark Vosburgh

In the late 1940s, a small group started development activities for smokejumper and cargo dropping in the Northern Region, headquartered in Missoula, MT. Under this program, regular aircraft patrols were used to detect fire, and methods were developed to parachute firefighters and supplies to remote fires. In 1953, largely because of the Northern Region's success in the use of aircraft for fighting forest fires, the Missoula Aerial Equipment Development Center (currently Missoula Technology Development Center or MTDC) was established.

These humble beginnings were the predecessor of the current National Technology and Development Program (T&D), which applies technology and equipment to save lives and money across all areas of the Forest Service. T&D centers are located in San Dimas, CA, and Missoula, MT.

John Kovalicky, now a smokejumper equipment specialist, started as a Missoula smokejumper in 1988, progressing to the positions of training and loft foreman. Following in the tradition of those innovative smokejumpers who started the program, Kovalicky joined MTDC as an equipment specialist in 2007. According to Kovalicky, his job "is to maintain standardization and to continue development work on everything it takes to get the smokejumper from the airplane to the ground, including the airplane itself. If there is anything on that aircraft that is unique to the smokejumper mission, then MTDC oversees the standardization and, in some instances, the fabrication and maintenance of that piece of equipment."

Mark Vosburgh is the fire and aviation program leader for the Forest Service's Missoula Technology and Development Center.

"The smokejumper program has always been very innovative, and this really is because the seven Forest Service smokejumper bases are involved with the development work."

Despite current differences in parachute systems between the Forest Service and the U.S. Department of the Interior, Bureau of Land Management (BLM), standardization of equipment and procedures allows jumpers from these agencies and, sometimes, Canadian smokejumpers to perform side by side as an aerial-delivered firefighting resources. Describing the importance of standardization, Kovalicky explained: "One of the things that makes the smokejumper program successful is that any smokejumper can show up at any of the seven Forest Service and two BLM jumpbases and the equipment and procedures are the same. When you get on that airplane, it is configured the same, and the spotter will put you out the door of that aircraft consistently and safely."

Grob's technology allows us to really see what is going on. Sometimes we see things that have been going on for a long time, and it is not what we thought was happening.

"The smokejumper program has always been very innovative, and this really is because the seven Forest Service smokejumper bases are involved with the development work," Kovalicky said. "If you do not get the ideas right from the ground up, the chances of success are really reduced," he added.

Kovalicky works closely with the Forest Service Smokejumper Base Manager's Council, providing recommendations derived from development work on equipment and how it is implemented, utilized, and maintained. The council has the final say as to whether an individual piece of equipment is implemented.

An example of Kovalicky's work is a cargo delivery project to reduce the exposure of pilots, jumpers, and spotters to the risk of low-level

mountain flight. Currently, for a typical load of 10 jumpers, it can take up to 7 passes to deliver the tools and supplies that are critical to the smokejumper mission. Cargo runs are conducted at 150 feet to 200 feet (46 m to 61 m) above ground level (figure 1).

Describing the first attempt to solve the problem, Kovalicky said: "We saw there was an opportunity to drop (cargo) from higher altitudes to give pilots more decision space if something went wrong." Cargo was dropped with the parachutes reefed (not fully deployed) until a height of 150 feet (46-m) above ground level, where a timer-activated release system allowed the cargo chute to deploy. Kovalicky described the system as "simple in concept, but difficult in practicality" due to the large number of variables (wind speed, cargo shape, cargo orientation, aircraft speed, etc.) involved. As often happens in technology development work, the original concept was discarded, lessons learned were carried forward, and a new solution was developed.

The second phase of the project is to develop and standardize the equipment needed to "stack" cargo by strapping it together, doubling the amount per pass and reducing flight exposure by 50 percent. Meanwhile, the reusable timed-release device originally tested has found use in deploying parachutes during torso dummy test drops. Previously, pyrotechnic cutters costing $50 per drop were used for this purpose. The timed-release device, with further development, has potential for use as a backup parachute actuation device for jumpers experiencing their first training jumps.

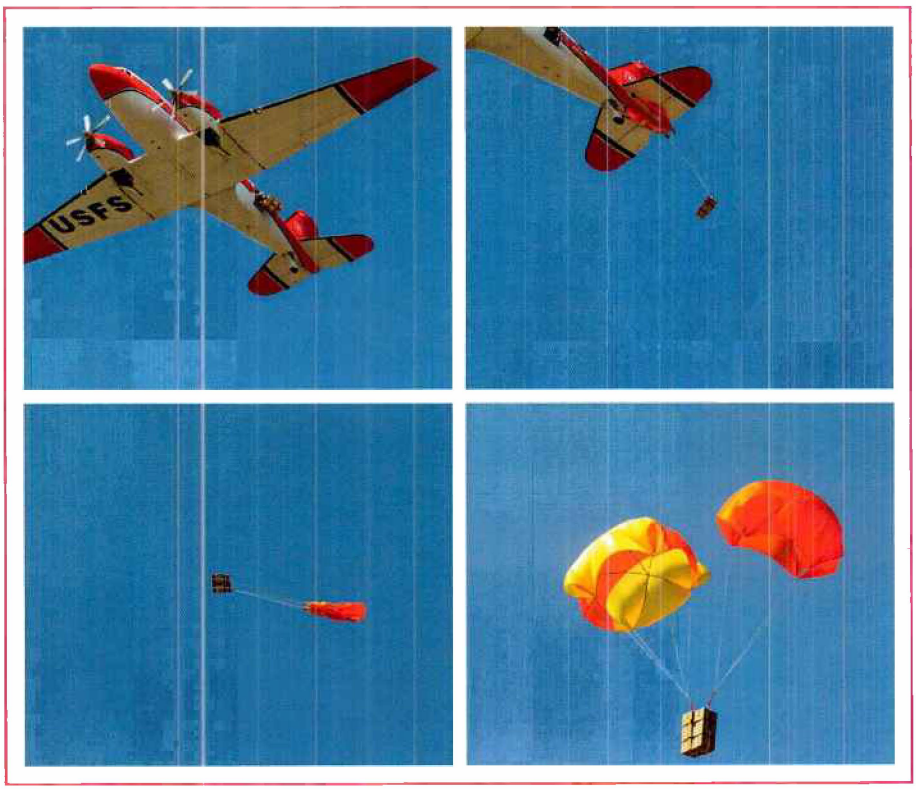


Figure 1.–*Still images captured from over a mile away with a high-speed video recorder, visually documenting an experiment to double the size of jumper cargo drops (tools and supplies) in an effort to find better ways to safely deliver cargo and reduce the number of low-level aircraft passes required to supply smokejumpers on the ground.*

Another project headed by Kovalicky was the development of a flight data recorder for smokejumpers. Working with engineers and developers in the private sector, Kovalicky envisioned a "pie in the sky" device that he could "strap on a jumper" and retrieve hard data on parachute performance. This data could be used to remove subjectivity and variability in feedback from individual jumpers.

The device, according to Kovalicky, "allows us to know with precision the current parachute performance capabilities we have" and compare it to other parachutes of interest. A micro SD card in the device records numerous variables including, altitude, rate of descent, rate of turn, and air speed. An internal gyro captures body position, and an accelerometer measures parachute opening and landing shock. Data from the device has proved valuable in understanding how parachute modifications affect parachute performance. The data also allows jumpers to examine their jumps to see exactly how critical parameters such as altitude loss and separation distance (between jumpers) are affected by various maneuvers.

High-speed photography has been utilized in the T&D program for many years. In describing how rapidly developing technology of high-speed photography has revolutionized the assessment of parachute performance, Kovalicky said: "When I came to T&D 8 years ago, I thought the photography that Ian Grob (MTDC photographer) provided was really cool, but now he can shoot clearer, crisper footage from farther away (more than 1 mile [1.6km]) and process it much more quickly."

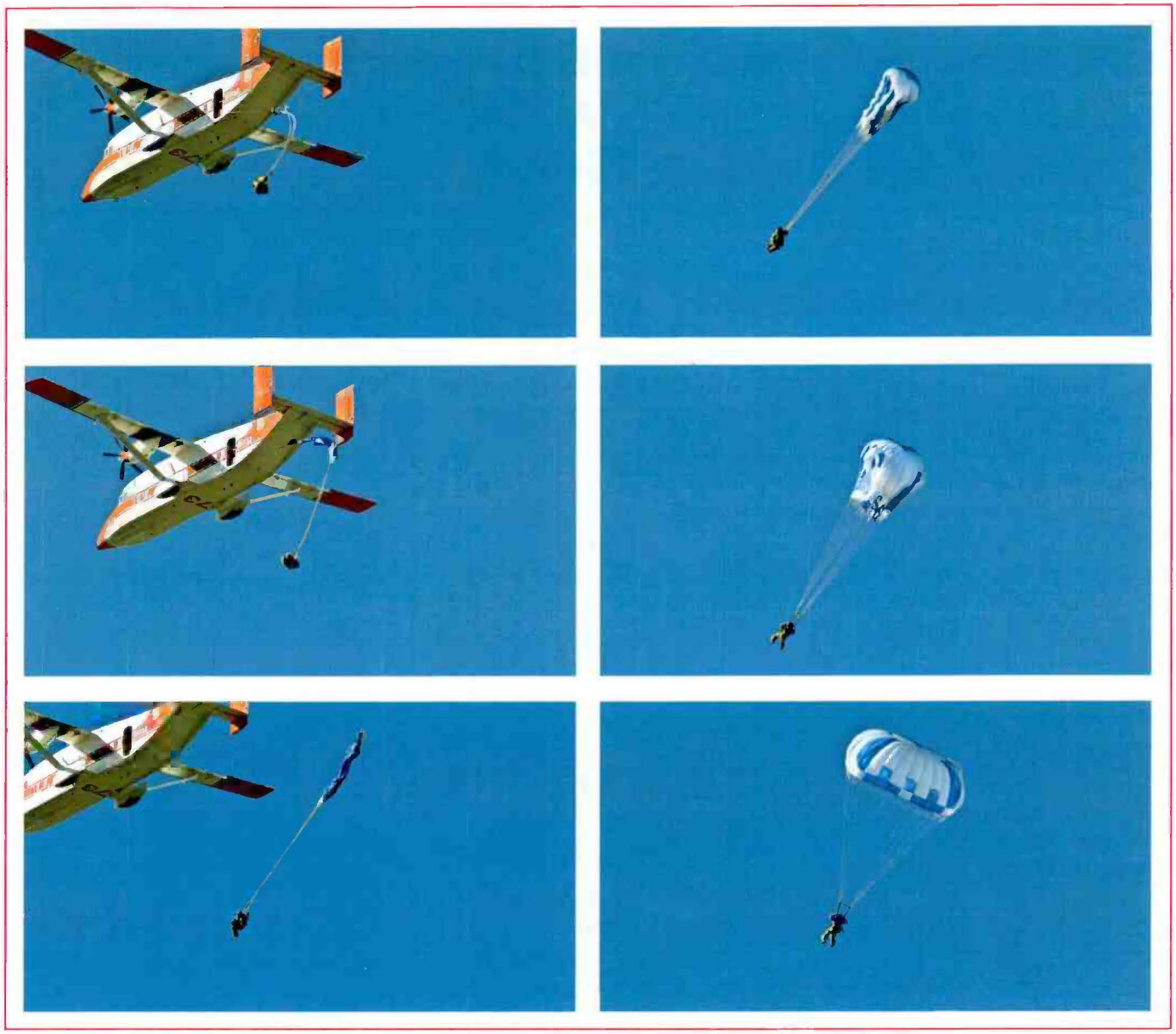


Figure 2.–*Technology using high-speed imagery capture employed in analyzing practice jumps.*

Explaining how high-speed imagery benefits smokejumper and T&D programs, Kovalicky said: "In a normal jump, the trainer can see the effects of (jumper) body position on the deployment of the canopy, either good or bad." He continued, "From a T&D perspective, any time we make a modification, Grob's technology allows us to really see what is going on. Sometimes we see things that have been going on for a long time, and it is not what we thought was happening. It (the video footage) is very educational" (figure 2).

Videos are shared with smokejumper trainers to show the effect of body position on the deployment of the canopy. The impacts of parachute modifications can be carefully analyzed. Kovalicky described analyzing videos from a series of dummy test drops where he could clearly see details that he said "happened in the blink of an eye and were not even noticeable from the ground." These details revealed a serious problem with a test modification. The video analysis armed Kovalicky with the knowledge he needed to accelerate the project by quickly abandoning the original modifications and moving on to more promising options.

The innovations of early smokejumpers continue today through the collaborative efforts of the national smokejumper program and the Forest Service's T&D program at the MTDC.

For more information, visit <http://fsweb.mtdc.wo.fs.fed.us/programs/fire/.> ■

Fireworld: How a Firefighter's Experience Informed a Career Focused on Climate Change

Nicky Sundt

It was August 30, 1987; the summer was drawing to a close. After 3 years of drought and a hot summer, fuel conditions in northern California and southern Oregon were primed for fires. That evening, dry thunderstorms pounded that region with more than 1,600 lightning strikes. I was among the smokejumpers who were dropped in southwestern Oregon on a fire that had explosive potential. Two months later, on November 9, 1987, the fire was finally controlled. It became known as the Silver Fire, and it burned almost 100,000 acres (404 km^2). At that time, it was the biggest fire in Oregon since the legendary Tillamook Burn of 1933. The suppression cost was about $20 million.

By the time the Silver Fire was controlled, I was back in Washington, DC, at the Congressional Office of Technology Assessment. I was working on the Forest Service's first climate change assessment. Up until then, my firefighting career in the West had been loosely intertwined with my career in DC, which focused on national energy, environment, and natural resource policy.

But, over the next 2 years, the two strands became tightly linked around the climate change issue.

Nicky Sundt is the climate change communications director at the World Wildlife Fund. He was a firefighter, hotshot, and smokejumper for the Forest Service from 1976 to 1990.

> Forests were being viewed as potential carbon sinks that would partially offset the need to curb fossil fuel emissions.

Even though my firefighting work for the Forest Service ended in 1990, I have drawn on my Forest Service experience frequently. I have addressed the extensive and crucial interconnections between climate change, wildfires, and public policy.

1976–1981: Graduate School and Initial Firefighting Experience

In mid-June 1976, after graduating with a Bachelor of Science in Conservation and Resource studies at the University of California (U.C.), Berkeley, I received a letter that dramatically altered the course of my summer and my subsequent career. It was from the Umatilla National Forest in Oregon. "We are pleased to offer you a GS-3 forestry aid (fire) position," it said. I accepted the Forest Service job and, the next day, started hitchhiking to Oregon. I was assigned to a helitack crew, but it was a cool and damp season with few fires. In contrast, the 1977 fire season was very active, and I stayed busy as a member of the Wallowa-Whitman Interregional Crew stationed out of La Grande, OR.

Nicky Sundt and his brother Matthew, Redmond Air Center, Deschutes National Forest, Redmond, OR, Summer 1983. Both Nicky and Matthew were smokejumpers in 1983. Photo provided by Nicky Sundt.

In the fall of 1977, I began graduate studies with U.C. Berkeley's Energy and Resources Group. Instead of spending the summer of 1978 firefighting, I worked as an intern with the Energy and Power Subcommittee of the House Interstate and Foreign Commerce Committee. That was the beginning of my policy work in Washington, DC.

The following summer, after completing course work for my master's degree, I worked on the Bridger-Teton National Forest helitack crew based in Jackson, WY. That fall, I headed back to DC to look for work relating to energy, the environment, and policy. Before I could find work, the Deschutes National Forest in Bend, OR, offered me a smokejumper position at the Redmond Air Center for the summer of 1980. After an eventful season as a rookie smokejumper, I once again returned to DC in the fall of 1980 to resume my search for full-time, permanent work. With the economy in recession, I did not find what I was looking for. So, I returned to Redmond for a second season of smokejumping in the summer of 1981.

1982–1990: The Congressional Office of Technology Assessment and Final Years Firefighting

The following winter, I applied for work at the Congressional Office of Technology Assessment (OTA). At the time, OTA was launching an assessment on wood use: U.S. competitiveness and technology (report published in 1983). Although I did not have the forestry experience of some of the other applicants, I was the only experienced firefighter and smokejumper among the applicants. That experience worked to my advantage. I was offered the job and accepted it in April 1982. For the first time, my career was bumped forward unexpectedly by my firefighting background.

However, I was increasingly concerned that the opposite could happen: forests could become net carbon sources, with wildfires accelerating the transition while creating a voracious demand for fire suppression funds.

Although I skipped the 1982 fire season, I was able to go back to Redmond to jump in 1983. I worked at the North Cascades Smokejumper base (Okanogan National Forest) outside of Winthrop, WA, in 1985 and 1987—the year of the Silver Fire. Each fall after jumping, I returned to work at OTA, where managers were very tolerant of my unusual seasonal pastime.

During my final stint at OTA, from the fall of 1987 to the summer of 1990, I worked on OTA's first climate assessment, which culminated in the publication of "Changing by Degrees: Steps to Reduce Greenhouse Gases" in February 1991. In the middle of that period were the extraordinary drought, heat, and wildfires of 1988. There was a surge of interest in and concern about climate change. Forests were being viewed as potential carbon sinks that would partially offset the need to curb fossil fuel emissions.

I was increasingly concerned, however, that the opposite could happen: forests could become net carbon sources, with wildfires accelerating the transition while creating a voracious demand for fire suppression funds. Carbon stocks could literally go up in smoke, increasing the need for sharp reductions in fossil fuels. This concern was reflected in the 1991 assessment report, which warned that climate-change-induced changes in the frequency and intensity of episodic disturbances, such as wildfires, "could hinder efforts to reduce deforestation or increase carbon," and could "have greater effects on forest biomass and composition than would changes in average conditions."

Photo provided by Nicky Sundt.

In October 1988, I participated in a workshop on Wildfire Severity and Global Climate Change at the National Center for Atmospheric Research in Boulder, CO. I told the workshop participants about my first-hand experience fighting fires and my growing concerns that Americans were not responding adequately to the threat of climate change. The following year, in July 1989, I presented a paper at the 14th Annual Hazards Research and Applications Workshop on "Budgetary Levels and Flexibility: The 1988 Fire Season and Beyond."

The 21st Century

In late 2000, I joined the coordination office of the U.S. Global Change Research Program (USGCRP) as the communications director. In 2008, I shifted over to a similar position in a different organization, the World Wildlife Fund (WWF). While with the USGCRP, I did what I could within the USGCRP to raise concerns about the issue. Once I joined WWF, I was able to more actively communicate around the matter and, over the last 6 years, I have done so periodically.

As I had feared since the 1980s, wildfires have grown larger, along with expenditures of public funds for fire suppression. During my first decade of firefighting (1976–1985), wildfires burned a little less than 3.3 million acres (13,355 km^2) annually. Over the last decade (2004–2013), average annual acreage burned amounted to nearly 7.3 million acres (29,542 km^2)—more than twice the acreage burned 30 years earlier. Fire suppression budgets have grown dramatically as well, from an annual average of $400 million in the decade from 1985 to 1994, to an annual average of $1.5 billion from 2004 to 2013.

Frustrated by the lack of policy progress around climate change and alarmed about wildfire trends, I wrote a piece for the Huffington Post in September 2012. In the piece, titled "To Politicians Napping on the Fireline: Wake Up, Smell the Smoke and Act on Climate Change," I urged national elected officials to take climate change seriously.

Since then, published research results have confirmed the concerns I have expressed since 1988. In 2012, the Forest Service report on *Effect of Climatic Variability and Change on Forest Ecosystems: A Comprehensive Science Synthesis for the U.S. Forest Sector* said that, "Recent forest sector projection scenarios for the 2010 Resource Planning Act Assessment suggest that ... U.S. forests could become a net C emitter of 10s to 100s of TgC/year within a few decades." And, 18 months later, USGCRP concluded in its report, *Climate Change Impacts in the United States*: "Climate change is exacerbating the major factors that lead to wildfire: heat, drought, and dead trees. Between 1970 and 2003, warmer and drier conditions increased burned area in western U.S. mid-elevation conifer forests by 650%. Climate outweighed other factors in determining burned area in the western U.S. from 1916 to 2003 .... More wildfires are projected as climate change continues, including a doubling of burned area in the southern Rockies, and up to 74% more fires in California." For the Pacific Northwest, where I had spent my entire firefighting career, the report warned: "By the 2080s, the median annual area burned in the Northwest would quadruple relative to the 1916–2007 period to 2 million acres (13,355 km^2), range 0.2 to 9.8 million acres (809 km^2 to 39,659 km^2), under a scenario that assumes continued increases in emissions through midcentury and gradual declines thereafter."

And so, nearly 40 years after my firefighting career started with a job offer from the Umatilla National Forest, and nearly 25 years after I last fought fire, circumstances still continue to compel me to weave what I learned on the fireline into my efforts to influence U.S. climate policy. Wildfires and climate change continue for me to be burning issues. ■

The Anatomy of Smokejumping

Katie Scheer

What separates the sexes, other than our anatomy, is oftentimes more obscure and benign than people think. I found that as a female smokejumper, it was size and weight, not gender, which was divisive. I have worked with tall, strapping women as well as small, wiry men. While grinding through a heavy pack-out, I was often jealous of my larger counterparts. Watch them land, however, and the envy is short lived. While my parachute landing falls were perhaps not the most graceful, some of my larger counterparts hit awfully hard. Speaking as a female, I find that gender differences trend more towards irritation than segregation. Bodily functions and the search for decent cover are the bane of every female firefighter.

Firefighting, especially smokejumping, is an exercise in outlasting the uncomfortable. Men and women have different tolerance thresholds. I think it has little to do with gender; rather, it is each individual's assessment and subsequent reaction to a given situation. Can women go without showers, eat crappy food, pack out 100-plus pounds (45 kg), be on the road for months, get dirty, run a chainsaw, climb trees, endure poison oak and foot rot? Of course they can; it has been proven. A more pertinent question to ask is, perhaps, do they want to? In my experience, the answer has often been "not so much." Certainly, there are many accomplished female firefighters, but there are far more men. Again, I think it is less of a gender issue and more one of taste. We ladies are as horrified to expose, as men are to discover, that after 2 weeks of no showers we can often outshine them in both odor and general lack of hygiene. I felt quite at home among my malodorous comrades, but I am sure that not every female would feel as comfortable, and for that matter, not every male would either. If lack of sleep, stinky feet, and incessant fretting over one's toilet paper supply does not raise an eyebrow, it seems only natural that fellow firefighters would have similar constitutions.

Firefighting, especially smokejumping, is an exercise in outlasting the uncomfortable. I think it has little to do with gender; rather, it is each individual's assessment and subsequent reaction to a given situation.

Over the years, I have worked on countless fires. Thinking back, it is not only hard to separate one fire from another, but also to separate the good from the bad. It has all melded together for me by some evolutionary trick; the bad seems to always dim before the good. I remember packing out in the deep snow and, while taking a moment to rest, falling backwards into a tree and remaining there, struggling until I was pulled free. I do not remember how many hours we slogged through snow or what it felt like when I heard the truck's horn sound in the dimming light, signaling our proximity to the road. What I do recall, with an almost crystalline quality, is riding home with my coworker and fellow pack-out sufferer, Mark Hentze, late that night. I was balanced on the luggage rack of his scooter, jump helmet on, with the rush of warm night air on my face as we zipped and swerved along the silent streets of Redmond, OR.

I could regale you with tales of exquisite alpine lakes jumped; of towering tamaracks, tiny jump spots, and the fear of treeing up; and of botched exits, clumsy parachute-landing falls, and center punching the jump spot. I could tell tales of the dismay you experience when you find you are the recipient of a food box whose only ingredient is meal, ready-to-eat meatloaf, and the delight when you find a packet of M&M's ® stuffed inside your chainsaw box. Other tales include watching your friends auger into rocks or land like feathers and hoping that the pilot nails the cargo; making late-evening jumps as the sun is setting and going on long walks in the dark trying to find the fire; as well as going on prescribed fires in the South and the depression that sets in when you realize that the only food served in town is barbecue or deep fried; or of laying under

Katie Scheer is a hotshot in Prineville, OR. She was a smokejumper for the Forest Service in both the Redmond, OR, and Redding, CA, smokejumper bases.

the stars on a "two manner" fixing the world's problems and working through the night on a "gobbler" with multiple loads.

I jumped, fell, slipped, and starfished out of a variety of airplanes more than 100 times. I worked for both the Redmond and Redding Forest Service smokejumper bases and had the pleasure of boosting many different bases and satellite airports. It was as exciting as it was tedious. I jumped big and little fires from Alaska to Southern California, but I was neither injured nor mistreated. At times it was blazing hot, while other times I froze. I lit fires all along the Southern States and climbed countless trees while hunting for the Asian Long Horned Beetle in Massachusetts. I rode in vehicles more than I jumped, though I would have preferred the reverse.

My experience working with a majority of males has taught me that those men, as much as women, are in need of friends. To the older men, we are the daughters. To the younger men, we are sisters and friends. At times, we are also mothers to the men with whom we work. I have made friends that will last a lifetime. It is those friendships that I value the most from my years as a smokejumper and wildland firefighter. Undoubtedly, there are amazing people in all walks of life; I just happened to meet most of my favorites as a firefighter. ■

Veterans Fire Corps

In its third year, the Veterans Fire Corps program is operated as a partnership between the Forest Service and the Student Conservation Association. The initiative builds on the knowledge, leadership experience, and training of men and women who served in the armed forces, retraining them and refocusing their mission to protecting public lands from the threat of wildfire.

The experience and training provided in the program are designed to prepare participants to meet pressing conservation needs on public lands while providing job training for future employment in the wildland firefighting field.

Crews work directly with the Forest Service and receive training and hands-on work experience in forestry and firefighting skills through the California Conservation Corps (CCC) Veterans Program. Funding for the crews is provided by the Forest Service through a partnership with the CCC, as well from the operating budget of the California State Assembly.

After completing 500 hours of work experience, veterans may become eligible for the Forest Service's Wildland Firefighter Apprenticeship Program, which can lead to journey-level positions.

The training can lead to full-time positions working as smokejumpers, as heavy equipment operators, on engine and helitack crews, as hotshots, and as dispatchers.

Programs such as these are a win-win for veterans, as well as the Forest Service. It gives veterans an opportunity to learn a new skill and determine if firefighting could become a second career.

For additional information, please visit: <http://www.veteransfirecorps.org/>.

Developing the Santa Ana Wildfire Threat Index

By: Tom Rolinski

Introduction

Every fall and winter, fierce Santa Ana winds blow across southern California from Ventura County southward. Fuels are driest during this time of year, which can lead to the gathering of the necessary components for large catastrophic fires to occur. Such instances happened in 1993, 2003, 2007, and 2008. The 2007 firestorm generated interest in developing an index to categorize Santa Ana winds. With the development of a wind index, fire agencies, first responders, private industry, and the general public would have access to information about an event's potential impact on their city. By providing value-added information about an impending event, the index could also help the National Weather Service's "Fire Weather Watch" and "Red Flag Warning" systems.

Santa Ana wind events vary in frequency, intensity, and spatial coverage from month to month and from year to year, thus making them difficult to categorize. The Predictive Services Unit, functioning out of the Geographic Area Coordination Center in Riverside, CA, includes several meteorologists employed by the Forest Service. In 2009, Predictive Services developed the Offshore Flow Severity Index, which categorizes Santa Ana wind events based on the potential for a large fire to occur. This unique approach addresses the main impact Santa Ana winds could have on the residents of southern California beyond the casual effects of windy, dry weather. During the past 3.5 years, the Forest Service (through Predictive Services) has collaborated with the San Diego Gas and Electric utility and the University of California at Los Angeles (UCLA) to develop the Santa Ana Wildfire Threat Index (SAWTI), which is a more mature version of the original index that Predictive Services developed.

The SAWTI domain covers the coastal, valley, and mountainous areas of southern California from Point Conception southward to the Mexican border (figure 1). The area has four zones based in part on the different offshore flow scenarios that occur across the region. Other factors that led to the division of zones were changes in terrain, National Weather Service Forecast Office boundaries, and local news media market areas. SAWTI is also a tool to help the general public prepare for impending events that could lead to catastrophic fires. Using the various zones simplifies the index and makes it more accessible for all user groups.

Methodology

Large Fire Potential–Weather Component

Since the index relates Santa Ana winds to anticipated fire activity or fire behavior, we first examined our definition of fire potential. We defined fire potential (or large fire potential) as the ability for an ignition to reach or exceed 250 acres (1 km^2). This number is valid for the lower elevations of southern California and is significant because, based on historical records, this is usually when more resources are brought in from

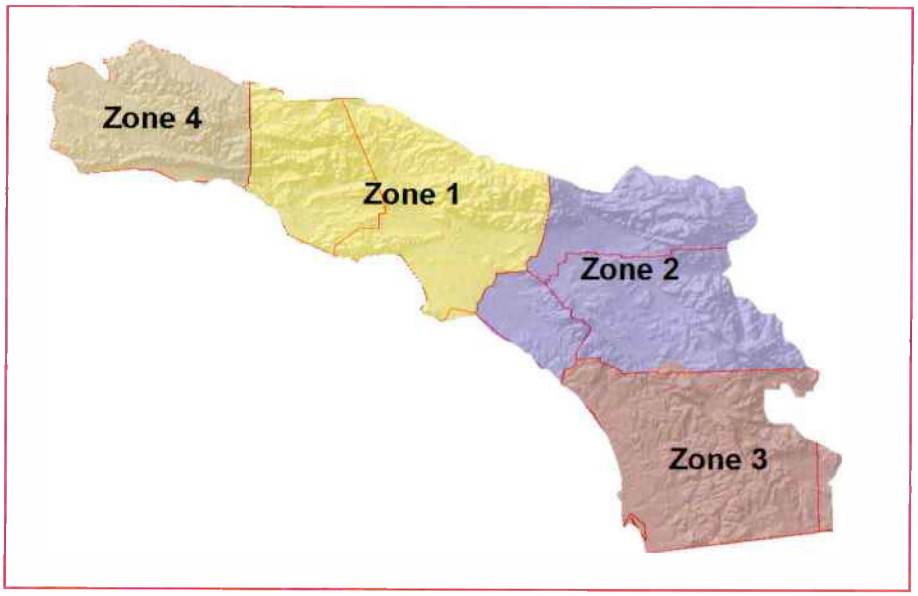


Figure 1.–*Santa Ana Wildfire Threat Index zones.*

Tom Rolinski is the predictive services program manager for the Forest Service in Riverside, CA.

outside the fire origin. The SAWTI incorporates weather and fuel conditions, using high-resolution computer model data.

By making the assumption that fuels are fully cured and supportive of rapid fire growth, large fire potential is greatest beginning with the antecedent weather conditions, namely how windy and how dry the atmosphere is. Thus, the weather component of the index consists of the surface wind speed and a measure of low-level atmospheric dryness or the surface dew point depression (dew point depression is the difference between the air temperature and the dew point temperature). Dew point depression depicts the dryness at the surface well and has a profound impact on fuel conditions. Also, dew point depression can sometimes differentiate better between warm and cold Santa Ana events than relative humidity can. Historically, larger dew point depression values of 70 °F (21 °C) or more have been associated with warm events. While this may seem trivial, cold Santa Ana wind events with surface temperatures 60 °F (16 °C) or below are usually not associated with large fires. This may be due in part to lower fuel temperatures because, in those cases, more time would be needed to reach the ignition temperature.

These two weather parameters are part of a mathematical equation, calculated at many computer model grid points across southern California over an 8-hour period (figure 2). When plotted on a map, it is easy to see where the worst Santa Ana conditions (from a weather perspective) are occurring or are forecast to occur. We chose an 8-hour time period for two major reasons. The first reason is that 8 hours is about the amount of time needed for the lighter fuels to respond to the atmospheric conditions. The second reason is because fewer than 8 hours of windy, dry conditions may not have a significant impact on the fire environment and, in some cases, may not even be classified as a Santa Ana wind event.

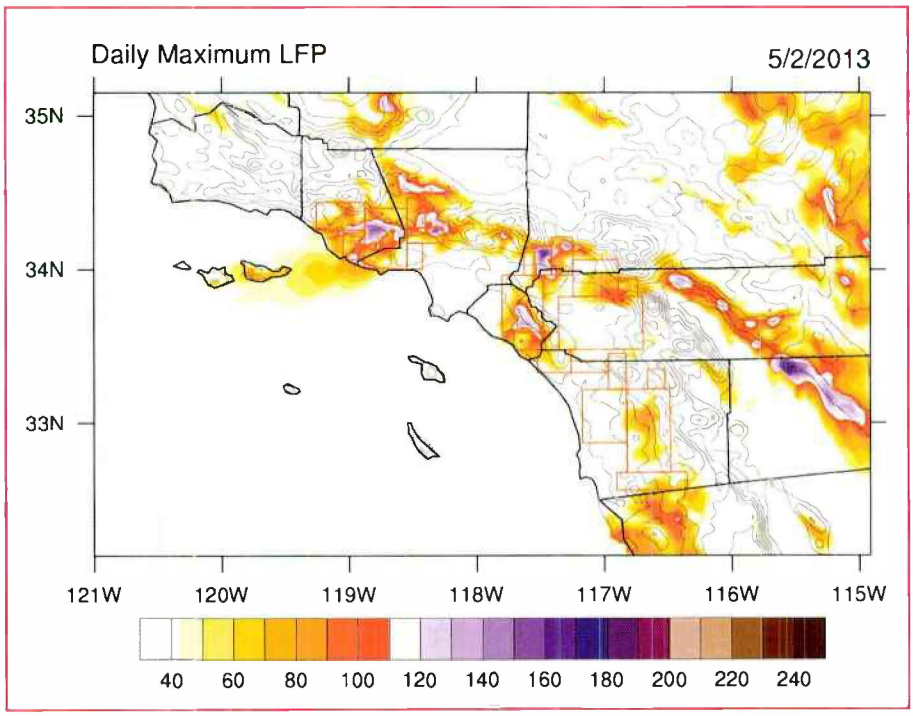


Figure 2.–*Large fire potential due to the combination of wind and low-level dryness.*

Large Fire Potential–Fuel Moisture Component

Large fire potential is also dependent on the state of the fuels. Given the complexity of the fuel environment (e.g., fuel type, continuity, loading, etc.), we decided to focus more on fuel moisture. The index incorporates three different types of fuel moisture variables: dead fuel moisture, live fuel moisture, and the state of green-up/curing of the annual grasses. Each of these three moisture variables has been combined into one term referred to as the Fuel Moisture Component. While the variables within this fuels component often act in cooperation, there are times when they are out of phase with one another due to the variability in precipitation (frequency and amount) across southern California in the winter.

Dead fuel moisture can be assessed by a variety of indices from the National Fire Danger Rating System (NFDRS). For the purposes of this index, we used a combination of the Energy Release Component (ERC) and the 10-hour dead fuel moisture time-lag. Combining these two indices is important because the 10-hour dead fuel moisture time-lag does well in detecting short-term changes in dead fuel moisture and the ERC captures long-term dryness. This becomes critical in the context of a Santa Ana wind event because a 2- or 3-day event will cause the dead fuels to dry, so much so that

during the first day of the event, the dead fuels may be too wet to support large fires, but by the second or third day, large fires become possible.

Live fuel moisture among the Chaparral species typically peaks sometime in the spring and reaches a minimum value around early to mid-October. Live fuel moisture is a difficult parameter to evaluate because of the irregularities associated with observed values. For instance, fire agencies take samples of different species of native shrubs twice a month across southern California. However, the sample times often differ between agencies, and the equipment used to dry and weigh the samples may vary from place to place. Also, sample site locations are irregular in distribution and observations from these sites may be taken sporadically. UCLA developed a proxy using soil moisture to estimate live fuel moisture among Chamise. Once live fuel moisture values begin to exceed 80 percent, the threat of large fires diminishes. But, during extended periods of warm, dry, and windy weather in the winter, large fires have happened despite the higher live fuel moisture levels. While Santa Ana winds have little or no impact on live fuel moisture, this aspect of fuel moisture does play a significant role in large-fire potential.

Once significant wetting rains begin to commence later in the fall, green-up of the annual grasses soon follows. While the timing and duration of green-up fluctuates from year to year, new grass is usually present by mid-December across southern California. During the green-up phase, grasses will begin to hinder fire spread, preventing new ignitions from occurring or reducing the rate of spread among new fires. In years when little rainfall occurs, green-up is either greatly minimized or is nonexistent. This leads to a greater potential for large-fire activity during the winter months, especially during Santa Ana events. The index incorporates a method to approximate the amount of green-up or curing that has taken place among the annual grasses.

The fuel moisture component modifies fire potential particularly in cases where fuels have not fully cured and are still inhibiting fire spread. This fuel modifier can become so influential that it will reduce or even eliminate the potential for large fire occurrence despite favorable meteorological conditions for rapid fire growth.

The Product

The SAWTI has five categories of severity ratings, ranging from "no-rating" to "extreme." A "no-rating" can either mean Santa Ana winds are not expected or that if Santa Ana winds are forecast, they will not result in significant fire activity. For example, if a strong Santa Ana wind event were to occur after appreciable rains or when fuels are wet, the event would be a "no rating." Tied to each threat level is a list of recommended actions that the public should take to better prepare for an impending event. Examples of some of these actions include: "Clean debris away from your house, charge your cell phone, and make sure you have plenty of gas." The list of recommended actions expands as the threat level increases. This aspect of the product is critical, as it serves to link categories of severity with public awareness messages.

The product consists of an online Webpage that displays a 6-day forecast of the above-mentioned categories for each of the four zones across southern California (figure 3). A map of the region stands as the centerpiece of the page and shows the categories that are color

Figure 3.–*Santa Ana Wildfire Threat Index as shown for November 2, 2014.*

coded ranging from grey (no rating) to purple (extreme). The product is issued once daily but will be updated more frequently if conditions warrant. The Webpage allows users to get more information, such as viewing the latest weather observation from select stations when zoomed in on the map. The Webpage will also display active and nonactive fires, via icons on the map, when such activity is present. Selecting one of these icons will provide the user with specific fire information, such as acreage burned, percent contained, and links to more data.

The product was beta tested for a year before becoming a public product in the fall of 2014. During the beta test phase, there were many Santa Ana wind events, some of which resulted in large, devastating fires. The index performed well in capturing all the events that occurred during the fall of 2013 through the spring of 2014, which ranged from "no rating" to "high." Fire agencies that had access to the index during this time used the product to make critical decisions about the allocation and mobilization of shared fire resources before significant fire activity occurred. The product was released to the public on September 17, 2014. Since that time, the product has been used by local news media across the San Diego and Los Angeles metropolitan areas, as well as *The Weather Channel*.

Summary

During the beta test phase, the index proved to be successful in capturing the severity of Santa Ana wind events. In particular, the index performed especially well during the Santa Ana wind events that resulted in the Camarillo Springs Fire, the Colby Fire, the Etiwanda Fire, and the fires across northern San Diego County. Since the official release to the public, the index has received positive feedback from fire agencies and the press. While not many Santa Ana wind events have occurred since the index was released to the public, it has continued to perform well and the Webpage has been frequently visited by users throughout the United States and other parts of the world. In the future, the goal is to have SAWTI become more integrated and used by the local media and the National Weather Service Red Flag Warning System. For more information, visit http://www.santaanawildfirethreat.com. ■

Assessing Firefighter Safety Zones Using LIDAR Remote Sensing

Philip E. Dennison, Gregory K. Fryer, Michael J. Campbell, Thomas J. Cova, and Bret W. Butler

Safety Zones

Safety zones are designated areas that reduce firefighter heat exposure to tolerable levels by providing separation between personnel and fuels. Along with **L**ookouts, **C**ommunications, and **E**scape routes, **S**afety zones are a component of the "LCES" procedures for reducing risk of injury and fatality (Gleason 1991). Firefighter safety and entrapment avoidance are dependent on accurate determination and effective use of safety zones. Guidelines have been developed for determining the safe separation distance (SSD) needed between fuels and firefighters (Butler 2014a), and minimum-safety-zone size can be calculated by using the SSD and adding the area required for the number of personnel and equipment needing protection (figure 1). Based on modeled radiative heat exposure, Butler and Cohen (1998) recommended that SSD should exceed a minimum of four times the flame height. The National Wildfire Coordinating Group has used this four-times-flame-height guideline for SSD, but also recommends increasing SSD downwind or upslope from a fire (National Wildfire Coordinating Group 2014). Continuing research suggests that the SSD should increase significantly as wind speed exceeds 5 miles (3 km) per hour or as slope exceeds 25 percent (Butler 2014b).

Philip Dennison and Thomas Cova are professors, and Michael Campbell is a Ph.D. student in the Department of Geography at the University of Utah. Gregory Fryer is a captain of the Cedar City Interagency Hotshot Crew. Bret Butler is a mechanical engineer at the Forest Service, Rocky Mountain Research Station.

Figure 1.–*A potential safety zone in Sierra National Forest near the study area used in Dennison, Fryer, and Cova (2014).*

Safety zones are typically determined onsite, based on perceptions of safety zone suitability and anticipated weather and fire conditions. However, perceptions of appropriate SSD and safety zone size may be flawed (Steele and others 2000). Light Detection and Ranging (LIDAR) remote sensing can be used to map vegetation height, providing fire managers with the ability to assess potential safety zones and their suitability over large areas prior to fire events. This article describes a spatial model for automated mapping of safety zones presented in Dennison, Fryer, and Cova (2014). The model used high-resolution imagery and LIDAR data, along with adjustable parameters, such as flame height, maximum safety zone slope, and number of personnel, to determine safety zone suitability. Additional outputs such as distance to the closest road and the presence of isolated trees can be used to further assess whether a safety zone might be appropriate for use by firefighters under specified conditions.

LIDAR

LIDAR remote sensing uses pulses of laser light to measure distance between the instrument and one more reflecting surfaces. Typically acquired from an aircraft, discrete elevations of both the vegetation canopy and the ground surface can be determined using LIDAR data. Vegetation height can be calculated using the difference between the "first return" from the top of the canopy and a "bare earth" elevation model calculated for the ground surface. Figure 2 contains a profile of first return and bare earth elevations, showing vegetation height

as the difference between the two elevations.

Dennison, Fryer, and Cova (2014) used a study area comprised of mixed conifer forest in the Sierra National Forest in California. LIDAR data was collected over an area of 5,400 acres (22 km^2) in August 2010 by the National Center for Airborne Laser Mapping. Gridded 3-foot (1-m) first-return and bare-earth elevation models were made available through the Open Topography Project (http://www.opentopography.org). Both vegetation height and ground surface slope were calculated from the elevation models at 3-foot (1-m) resolution over the entire study area. Color infrared orthoimagery, also at 3-foot (1-m) resolution, was used to calculate a vegetation index for separating vegetated cells from nonvegetated cells.

Safety Zone Mapping

Dennison, Fryer, and Cova (2014) calculated SSD as four times flame height for flame heights ranging from 7 feet to 46 feet (2 m to 14 m) in 3-foot (1-m) increments. The SSD buffered all cells with a LIDAR-derived vegetation height of greater than 3 feet (1 m). The study evaluated remaining unbuffered cells below the vegetation height threshold as potential safety zone cells using a decision tree. The vegetation height threshold and decision rules were empirically determined using the LIDAR and orthoimage data, but could easily be adjusted based on expert knowledge or training using known safety zone attributes. Safety zone cells were required to have vegetation height of less than 0.7 feet (0.2 m), a contiguous area of unbuffered cells at least 512 feet^2 (156 m^2) sufficient for 20 firefighters and 2 vehicles, and slope less than 10 degrees. Additional criteria and decision-tree details are described in Dennison, Fryer, and Cova (2014).

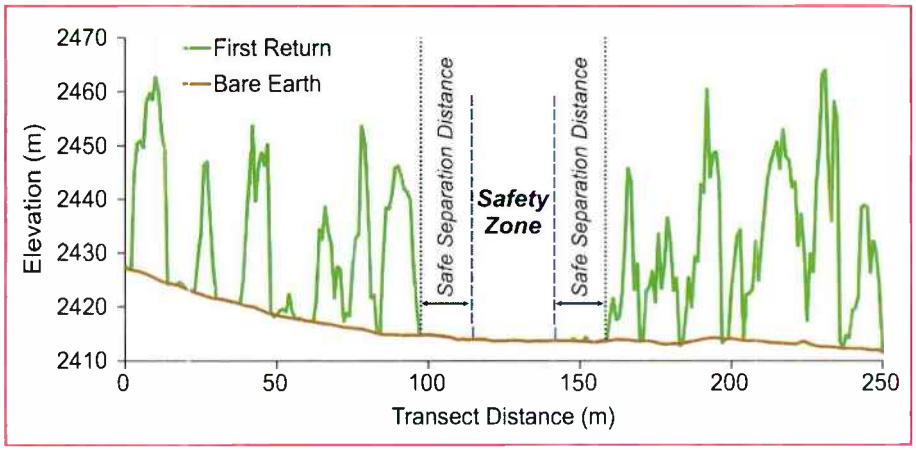


Figure 2.–*An elevation transect showing individual tree canopies and a potential safety zone. Vegetation height is the difference between the first return and bare earth elevation models. Scaling on the Y-axis has been exaggerated to improve visibility of vegetation height.*

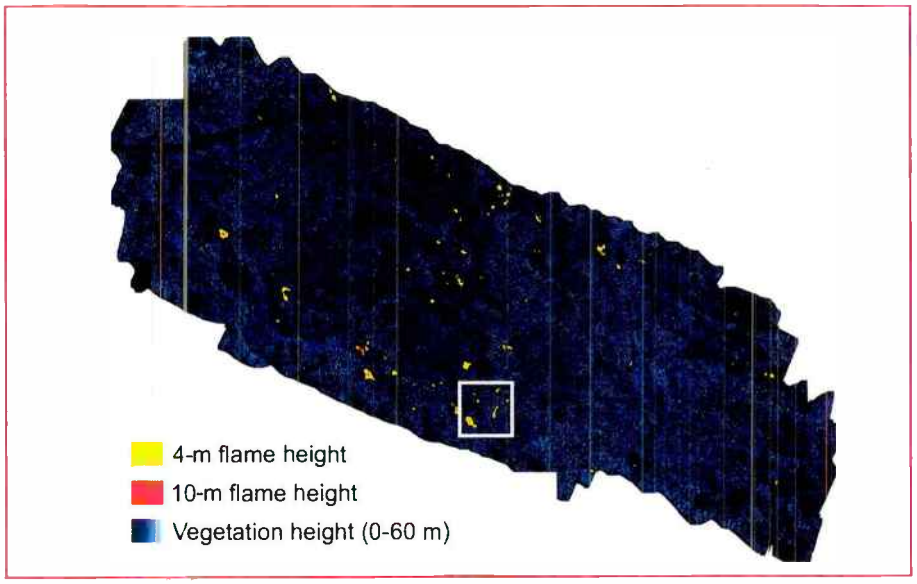


Figure 3.–*Safety zones mapped within the study area for 13-foot (4-m) and 33-foot (10-m) flame heights. LIDAR-derived vegetation height shown in the background is scaled from 0 feet to 200 feet (0 m to 60 m). The 82-foot (25-m) kernel was used for this example. The white box indicates the subset area shown in figures 4–6.*

Some potential safety zones might become adequate with treatment. For example, a few isolated trees in a large meadow could be removed. To increase safety zone size in situations where fuels treatment might be possible, an 82-foot (25-m) kernel was used to calculate the percentage of cells exceeding the 3-foot (1-m) vegetation height threshold. If less than 10 percent of the cells in the 82-foot by 82-foot (25-m by 25-m) matrix kernel exceeded the vegetation height threshold, then tree cover was considered sparse and the cell was not buffered by the SSD. Safety zones calculated using no kernel and safety zones calculated using the 82-foot (25-m) kernel were compared.

Most of the study area was found to be unsuitable for use as safety zones due to vegetation height or

slope exclusions. For a flame height of 13 feet (4 m) and no kernel used to exclude isolated trees from being buffered, 42 safety zones were found. These safety zones covered less than 0.2 percent of the 5,400-acre (22 km^2) study area. As flame height increased, the number and size of safety zones decreased. At 20-foot (6-m) flame height, 13 safety zones were found. At 33-foot (10-m) flame height, only three safety zones were found. Using a kernel to exclude isolated trees from being buffered resulted in a modest increase in the number of safety zones; 75 were found at 13-foot (4-m) flame height, 30 were found at 20-foot (6-m) flame height, and 5 were found at 33-foot (10-m) flame height (figure 3). Mean safety zone size increased when the kernel was used.

Figure 4 shows an example of safety zones determined by the spatial model for an approximately 62 acre (0.5 km^2) subset of the study area. The subset has a much higher density of clearings relative to the study area as a whole (figure 3) but was selected to provide examples of mapped safety zones with a range of characteristics. At 13-foot (4-m) flame height (52 feet SSD from the forest edge), a total of six safety zones were found. The portions of the clearings not shown as safety zones were excluded because of SSD, slope, and/or vegetation height criteria. At 20-foot (6-m) flame height (24 m SSD), only 2 of the safety zones are large enough to contain 20 firefighters and 2 vehicles. Figure 5 presents the same safety zones, but coded by the maximum flame height calculated for each cell in the safety zone. The safety zone in the lower left corner of the subset permits up to 33-foot (10-m) flame heights, while still sheltering 20 firefighters and 2 vehicles. Within the entire study area, no safety zones were found for flame heights greater than 13 feet (14 m) (56 m SSD).

Spatial modeling allows determination of both the area within each safety zone and the distance to the closest road, both important considerations for safety zone selection. At 13-foot (4-m) flame height, three potential safety zones are within a short distance of a road (figure 6). Two of these safety zones are relatively small, however. Only one of the three safety zones

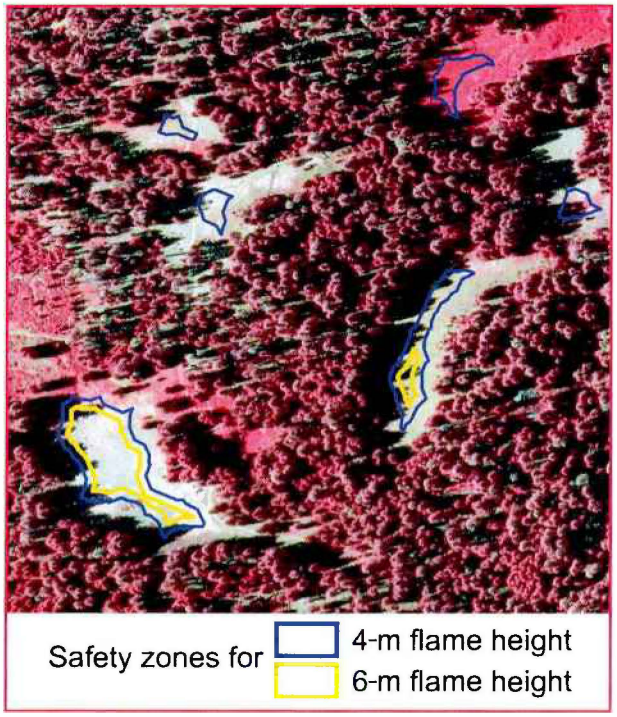


Figure 4.–*Safety zones calculated for 13-foot (4-m) and 20-foot (6-m) flame heights. The background image is a near infrared false color composite derived from the orthoimagery, with live vegetation displayed in red tones. Subset area is approximately 62 acres (0.5 km2).*

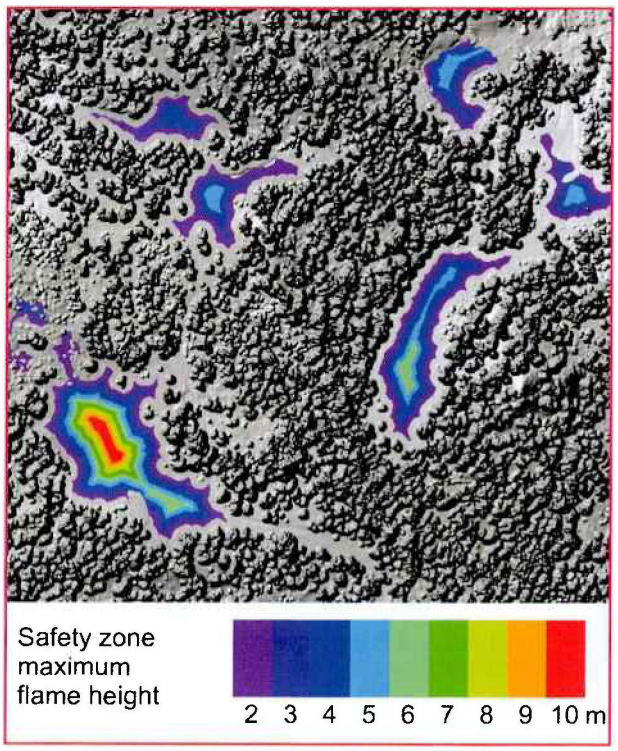


Figure 5.–*The maximum flame height that permits each cell to be part of a safety zone, while still maintaining sufficient space for 20 firefighters and 2 vehicles. The background image is a shaded, first-return surface showing individual tree canopies.*

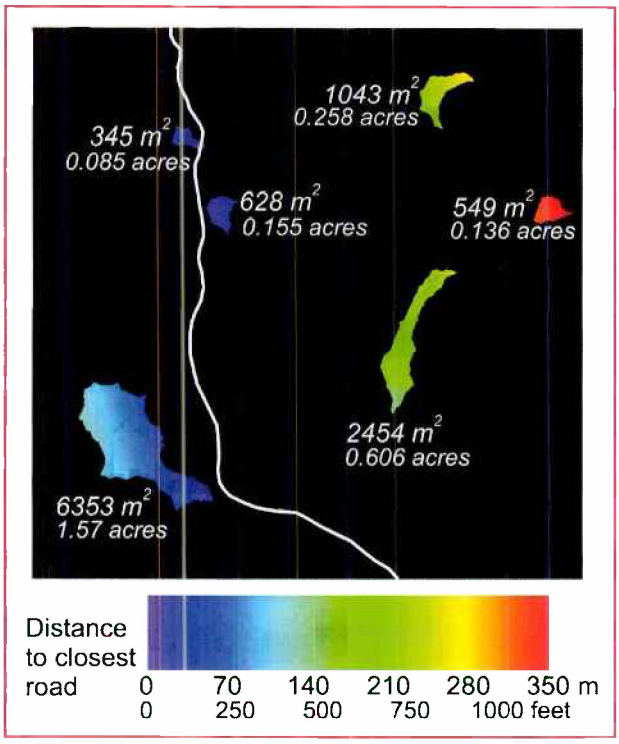


Figure 6.–*Safety zones calculated for 13-foot (4-m) flame height. Distance to a road (shown as a white line) is indicated by colors within each safety zone, while italicized numbers represent the total area of each safety zone.*

exceeding 0.25 acres (1,000 km²) is close to a road. Longer distances from the road and intervening terrain may make access more difficult for the safety zones on the right.

Discussion

The spatial model presented in Dennison, Fryer, and Cova (2014) provides a flexible framework for identification of safety zones in advance of resource deployment. Assessment of safety zones using this type of spatial model could provide important advantages to fire managers for determining safety zone viability, allocating resources, and assessing the feasibility of proposed operational strategies. LIDAR data allow accurate measurement of safety zone size, ensuring adequate SSD. Safety zones identified using LIDAR data will still need to be verified by resources on the ground, but vegetation cover within safety zones can be partially determined using high resolution imagery and LIDAR data, allowing assessment of potential improvements that may be required to make a safety zone suitable for use. Mapping of safety zones in advance will also allow access and travel time to be assessed, addressing the escape routes component of LCES. While LIDAR data are currently only available for limited areas, data availability will improve in the near future with national-scale programs such as the U.S. 3D Elevation Program (http://nationalmap.gov/3DEP/).

Dennison, Fryer, and Cova (2014) used uniform flame heights to map safety zones. Recent proposed improvements to safety zone guidelines are based on vegetation height and multipliers for slope and expected wind conditions (Butler, 2014b). Vegetation height and slope can be easily calculated from LIDAR data, and both variables can be mapped at high spatial resolution. Thus, the spatial model presented in Dennison, Fryer, and Cova (2014) should be readily adaptable to evolving safety zone guidelines based on vegetation height and slope. The authors of this article are currently working on comparing how LIDAR-assessed safety zone characteristics change when different safety zone guidelines are used. Travel time to safety zones and accessibility, both on foot and using vehicles (Fryer, Dennison, and Cova 2013), will also be included in future versions of safety zone spatial models. LIDAR identification of safety zones may be useful in the wildland-urban interface for determining whether structures have sufficient defensible space and for assessing structures and locations that may be suitable for shelter actions (Cova and others 2009).

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Federal Excess Trucks Save Seven in High-Water Rescue

Matt Weinell

Right after the Havana and Concord Volunteer Fire Departments in Gadsden County, Florida, leased two new Federal excess trucks from the Florida Forest Service, the trucks were called to action and used to rescue seven people from a flood in late December 2014.

Just 16 days after receiving the two Federal excess 2.5-ton, cab-over cargo trucks, firefighters were prepping them for new paint jobs. A critical midnight call, however, put the cosmetic transformation on hold. Heavy rainfall had caused the Ochlockonee River to flood, closing Fairbanks Ferry Road. The Havana and Concord Volunteer Fire Departments responded quickly, taking both of the Federal excess trucks. They found two individuals stranded on the hood of a car. The firefighters noticed that the car was leaning precariously against a guardrail. They acted swiftly, navigating one of the trucks through the high water to rescue the two people. The firefighters were able to drive close enough to pull them to safety on the back of the truck's cargo bed.

Six hours later, firefighters received a call that another car had driven past the barricades at Fairbanks Ferry and completely washed the vehicle off the road. This time, there were five people stranded and in danger. The group stood atop the only portion of the car that was above flood waters, the roof. With no time to spare, firefighters used the other Federal excess truck to maneuver close enough to facilitate rescue. The firefighters then used ropes to bring the group to safety.

Photo provided by Matt Weinell.

"I don't know what we would have done if we hadn't had those [Federal excess] trucks," said Concord Fire Chief John Browning. "It was a very close call."

The Florida Forest Service recently began leasing the new cargo trucks to rural fire departments after acquiring them through the Firefighter Property Program. For decades, the Florida Forest Service has helped rural fire departments obtain no-cost lease equipment through this program.

"These trucks were chosen for their ability to enhance the capabilities of our rural fire departments," said State Forester Jim Karels. "The Firefighter Property Program has been the backbone for rural and volunteer fire departments across the State." ■

The Florida Forest Service manages more than 1 million acres (4,046 km^2) of public forest land while protecting 26 million acres (105,218 km^2) of homes, forest land, and natural resources from the devastating effects of wildfire. To learn more about Florida Forest Service programs, visit http://www.FloridaForestService.com.

Photo provided by Matt Weinell.

Matt Weinell is a fire resource manager for the Florida Forest Service.

Smokejumper Invents the "Klump Pump"

Jim Klump

I grew up in a logging camp in Siskiyou County in northern California. One afternoon, my father and another logger took me to a small lightning fire on company land. I was 13 or 14 years old. As we were working this fire, I could see other fires across the Scott River in the Marble Mountains. From a distance, I noticed the smokejumpers working those fires. They amazed me. I knew from that moment on that one day that I would become a smokejumper.

In 1959, I began fighting fires seasonally at 16 years old. The summer I turned 18, I hiked into a fire on the Klamath with a buddy of mine; it took all night. As we were approaching the fire in the morning, an aircraft came over and four jumpers parachuted out of the plane. After we got a line on the fire, one of the jumpers asked what time we had started our hike into the fire. I told him before 6 p.m. the evening before. He chuckled and said, "At 6 o'clock last night, we were having pizza." I had never heard of pizza, much less eaten it.

Three years later, in 1964, I became a smokejumper. I was 21 years old, and I was a retread jumper for the next 10 seasons. In the summer of 1964, we were the first Forest Service crew to both rappel and parachute from a helicopter.

Jim Klump was a smokejumper for the Forest Service from 1964 to 1974 in Redding, CA.

As noted, the use of trade, firm, or corporation names in this publication is for the information and convenience of the reader. Such use does not constitute an official endorsement of any product or service by the U.S. Department of Agriculture.

In 1974, I became the division chief on the Truckee District of the Tahoe National Forest. Looking back, becoming a division chief at such an early age was a mistake on my part. I was a good firefighter; but meetings and all the other activities that go in at that level were not my forte. I lived from fire season to fire season and still enjoyed putting out fires. I worked my way up to Type II Incident Commander and Type I Operations Section Chief.

I retired on February 20, 1993, which happened to be my 50th birthday and the last day of the pay period. I started a business, which was successful, but I could not stop thinking about an idea for a mobile, self-contained apparatus for fighting fire in remote locations. Several years went by. One morning, I got up at 2:30 or 3:00 a.m., went to my kitchen dining table, and started writing and drawing. This became the format for a U.S. patent and my business plan for the "Klump Pump." The Klump Pump is a standard piece of equipment, outfitted with pump, hose, fittings, and foam. The idea was that it could be easily delivered to an incident and transported individually, by two- or three-unit trailers.

Photo provided by Jim Klump.

Next came the problem of financing; I felt I needed an investor. Finally, one day I spoke to a guy who said, "If it is such a good idea, why not spend your own money?" So, I mortgaged my house, spent my life savings, and borrowed some money. It was a risk to do some-

Photo provided by Jim Klump.

thing like this when you are in your fifties, but after overcoming many challenges, the project came together.

The concept of the Klump Pump is quite simple. In essence, it is a 1,000-gallon (3,785 L) fire truck without a chassis. The 1,000-gallon (3,785 L) open-topped tank has leveling jacks with articulating feet on each corner. The rectangular frame is 7 feet wide, 10 feet long, and 3 feet high (2 m x 3 m x 1 m). Three feet (1 m) of one end of the machine contains the pump, the plumbing, a 5-gallon (19 L) fuel cell, and an operator's panel. In a cage alongside is 2,200 feet (670 m) of hose, fittings, foam, and a tool kit. The unit weighs about 1,600 pounds (726 kg) when it is fully outfitted. Around the rim of the tank are four hard points where the lifting harness is attached. Helicopters transport the machine empty and then fill it at its drop site with the helicopter bucket. Unlike many portable systems, the Klump Pump can be moved with ease several times during the day.

The Klump Pump has been used on almost 90 fires in 3 Western States; everything from initial attack, extended attack, and project fires. I have built the fleet up to 11 machines. We always send a company representative to the incident to keep time and provide technical assistance.

Next season will be my 12th year on this adventure with the Klump Pump. I am looking at retiring, again, and passing the business on to someone who has the passion to keep it going. In closing, if a young jumper came up to me today and asked, "So, Mr. Klump, what is it all about?" I would tell that person that I have got it narrowed down to three things: lots of oats, pizza, and a clean exit. ■

Contributors Wanted!

We need your fire-related **articles** and **photographs** for *Fire Management Today*! Blogs should be between 100 and 200 words, Short Articles should be between 500 and 1,000 words, and Feature Articles should be between 1,500 and 2,000 words. Subjects of published material include:

Aviation
Communication
Cooperation
Ecosystem Management
Education
Equipment and Technology
Fire Behavior
Fire Ecology
Fire Effects
Fire History
Fire Use (including Prescribed Fire)
Fuels Management
Firefighting Experiences
Incident Management
Information Management (including Systems)
Personnel
Planning (including Budgeting)
Preparedness
Prevention
Safety
Suppression
Training
Weather
Wildland-Urban Interface

For more information, contact the managing editor via email at firemanagementtoday@fs.fed.us.

Reflecting on the Legacy of the First African-American Smokejumpers

Deidra L. McGee, Forest Service

A group of valiant men known as the Triple Nickles, the first African-American smokejumpers, paved the way for so many in the smokejumping cadre.

During World War II, a time when segregation was still a part of everyday life, 17 brave men took the plunge to serve their country. The battalion's original goal–to join the fight in Europe–was thwarted when military leaders in Europe feared racial tensions would disrupt operations. At about the same time, the Forest Service and the military were working together to minimize the damage by balloon bombs, which were launched by the Japanese with the intent of starting forest fires in the Western United States. In the end, less than 300 of the incendiary devices were known to have reached North America. The Triple Nickles were, nonetheless, instrumental in helping the Forest Service fight wildfires. They answered about 30 fire calls and made hundreds of jumps in the summer of 1945.

Private First Class Malvin L. Brown, a member of the Triple Nickles, became the first smokejumper killed when he jumped on a fire on August 6, 1945. He was the only Triple Nickle to perish on duty. A special ceremony to commemorate the 70th anniversary of Malvin Brown's death was held during the annual Triple Nickles' reunion in Baltimore in the fall of 2015.

In honor of the paratroopers, the Forest Service recently named a conference room after the Triple Nickles in its newly renovated national headquarters office in Washington, DC. ■

Private First Class Malvin L. Brown's headstone at Mt. Calvary Cemetery near Baltimore, MD.

Loadmasters from the 555th heave smokejumping gear into a C-47 in Pendleton, OR.

Early morning, August 6, 1945, Captain Richard (Black Daddy) Williams, battalion executive officer, and 1st Lieutenant Clifford (Jabo) Allen, jumpmaster, peer through the open door of the C-47 at the spot where they will drop the 555th's firefighting team.

Deidra McGee is the national liaison for Minerals & Geology Management, National Forest System for the Forest Service in Washington, DC.

Fireline Explosives

The Missoula smokejumper program has been directly involved with managing the use of Detagel Presplit X, a water-gel slurry high explosive. The Missoula smokejumper program has been using such explosives for both fire and field work since the 1960s. The smokejumper bases in Missoula and West Yellowstone, MT, are currently the only bases in the country that have a blasting program with qualified blasters.

What Are Fireline Explosives?

Fireline explosives are linear explosives that enable crews to construct fireline under certain conditions much faster and with less environmental impact than conventional methods. The quality of line constructed varies from a nearly finished line in light brush or grass fuels to a lower quality line than required in heavy brush and slash fuel types. Even in heavy brush and slash, the cleaning action of explosives can enhance access and effectiveness of fire crews who finish the line. Often, firelines in these fuel types can be "cleaned out" by a small crew using hand tools and a leaf blower.

Fireline explosives are also effective in falling hazard trees during line construction, but even more so during the mop-up and rehabilitation phase of a fire. Hazard trees that cannot be safely cut by a qualified sawyer can be brought down using explosives by a qualified blaster in a safe and cost-effective manner. Using explosives reduces the overall exposure to risk associated with working under a hazard tree by allowing a blaster to quickly attach explosives to the tree and then bring it down from a safe distance.

Advantages

As labor and overhead costs rise, fireline blasting offers real time savings. Smaller crews may be used to suppress fires because less cutting and/or digging handline is required, particularly in heavy fuels or ground cover. An increased speed of building the line can save wildland resources. Sometimes smaller crews equipped with explosives can be delivered to a fire faster than larger, conventionally equipped crews.

Other advantages include:

- Mineral soil in the line is loosened and is then easy to dig for use in hotspotting and mop-up.
- A fine layer of soil dusts fuels close to the line and acts as a retardant.
- Blasting is generally more environmentally sound than using chainsaws, handtools, or dozers.
- Fireline explosives are approved for use in designated wilderness areas.
- Fireline explosives can be delivered by para-cargo into extremely remote locations.

For more information on fireline explosives, please contact: Steve Reed, assistant loadmaster foreman, Forest Service, Missoula Smokejumper Base. Email: smreed@fs.fed.us.

Junior Smokejumper Program

Molly Cottrell

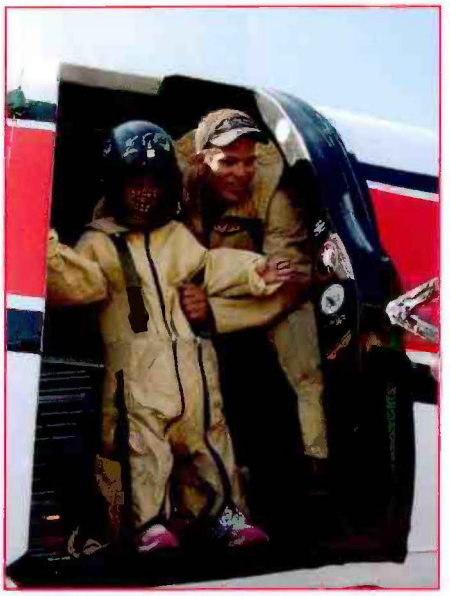
In the Forest Service, we developed the Missoula, MT, junior smokejumper program to educate children about fire ecology, fire management, and smokejumping in an exciting and interactive learning environment. We marked our sixth successful year of the program in 2014. In the program, we target children ages 6 to 12, but we have welcomed participants from ages 4 to 16. More than 1,400 children have attended, along with approximately 500 adults. The majority of the participants come from the Missoula area, but some have come from other parts of the country and/or abroad.

Molly Cottrell is the junior smokejumper program manager in Missoula, MT.

We start the program with a fire behavior lesson. For some kids, this is the best part of the experience because they get to watch the instructor demonstrate the effects of fire in a safe environment. The lesson introduces the concept of the fire triangle and explores how forest fires start and how they are suppressed. We use the matchstick forest (20 matches on a sloped board) to show how fire spreads and how fire can be contained. We choose one child to be the "firefighter" and give him/her a spray bottle to squirt water on the blaze, usually to the relief of parents and chaperones alike.

The kids then try out the smokejumper physical fitness test. They attempt to do pull-ups, push-ups, and sit-ups. The highlight for the group is usually the pull-ups. Occasionally, we get a kid who can do the smokejumper-required seven pull-ups!

For the final part of the program, we give groups tours in the smokejumper facility. In the tour, they get a better understanding about the function of the gear, parachutes, cargo, and tools. The kids are encouraged to try on a jumpsuit and helmet, all in children's sizes.



Finally, the group meets a smokejumper who walks them through a "practice jump" from a plane parked on the tarmac.

We then ask the kids to recount one thing they learned and their favorite part of the experience. After this, they receive an official "Junior Smokejumper" T-shirt or string backpack to take home with them. The junior smokejumper program is looking forward to another successful season of educating the next generation of Forest Service smokejumpers! ■

LANDSCAPE DEBRIS BURNING

Proper Debris Burning Prevents Wildfire

LEARN THE HOW, WHAT AND WHEN OF PREVENTING WILDFIRES FROM IMPROPER BURNING:

HOW

DON'T BURN UNLESS WEATHER CONDITIONS (PARTICULARLY WIND) ARE SUCH THAT BURNING CAN BE CONSIDERED SAFE.

KEEP A WATER SUPPLY AND SHOVEL CLOSE TO THE BURNING SITE.

A RESPONSIBLE ADULT IS REQUIRED BY LAW TO BE IN ATTENDANCE UNTIL THE FIRE IS OUT.

LANDSCAPE DEBRIS PILES MUST BE IN SMALL 4-FEET BY 4-FEET PILES.

4FT

10FT

CLEAR ALL FLAMMABLE MATERIAL AND VEGETATION WITHIN 10-FEET OF THE OUTER EDGE OF PILE.

WHAT

NO HOUSEHOLD TRASH OR GARBAGE CAN BE BURNED OUTDOORS AT RESIDENCES.

OK

DRY, NATURAL VEGETATION, GROWN ON THE PROPERTY CAN STILL BE BURNED OUTDOORS IN OPEN PILES, UNLESS PROHIBITED BY LOCAL ORDINANCES.

WHEN

DON'T BURN IF IT IS WINDY AND THE SURROUNDING VEGETATION IS VERY DRY.

PERMITS

BURNING CAN ONLY BE DONE AFTER OBTAINING REQUIRED PERMITS FOR PERMISSIVE BURN DAYS. CHECK BURN DAYS BY CONTACTING YOUR LOCAL AIR DISTRICT.

ONE LESS SPARK
ONE LESS WILDFIRE

FOR MORE INFORMATION AND A PRINT-READY CAMPFIRE PERMIT VISIT:
PREVENTWILDFIRECA.ORG
#PREVENTWILDFIRE #ONELESSSPARK

BROUGHT TO YOU BY THE CALIFORNIA WILDLAND FIRE COORDINATING GROUP (CWCG)

OPEN CAMPFIRE SAFETY RULES

Campfire Safety to Prevent Wildfire

LEARN HOW TO BUILD AN OPEN CAMPFIRE, MAINTAIN IT DURING THE BURN TIME AND HOW TO EXTINGUISH AN OPEN CAMPFIRE WHEN FINISHED:

BUILD

TO BUILD AN OPEN CAMPFIRE

- SELECT A LEVEL, OPEN LOCATION AWAY FROM HEAVY FUELS SUCH AS LOGS, BRUSH OR DECAYING LEAVES AND NEEDLES.
- 5 FT — CLEAR AN AREA AT LEAST 5 FEET FROM FIRE'S EDGE (LOCAL REGULATIONS MAY VARY).
- SCRAPE AWAY GRASS, LEAVES OR NEEDLES DOWN TO THE MINERAL SOIL.
- CUT WOOD IN SHORT LENGTHS, PILE WITHIN CLEARED AREA AND LIGHT THE FIRE.
- SCOOP A DEPRESSION IN THE CENTER OF THE CLEARED AREA IN WHICH TO BUILD THE FIRE AND PUT A RING OF ROCKS AROUND IT.
- THE FIRE SHOULD BE BUILT NO LARGER THAN NECESSARY FOR COOKING OR PERSONAL WARMTH.
- YOUR FIRE MUST NEVER BE LEFT UNATTENDED AND THE FIRE MUST BE EXTINGUISHED COMPLETELY BEFORE LEAVING.

BURN

THE FIRE IS BURNING

- KEEP A SHOVEL AND BUCKET OF WATER NEARBY AT ALL TIMES.
- WHILE THE FIRE IS BURNING, BE SURE THERE IS A RESPONSIBLE PERSON IN ATTENDANCE OF THE FIRE AT ALL TIMES.
- NEVER LEAVE CHILDREN AROUND A FIRE UNATTENDED.

OUT

COMPLETELY EXTINGUISH AN OPEN CAMPFIRE

- USE THE "DROWN, STIR AND FEEL" METHOD: DROWN THE FIRE WITH WATER, THEN STIR AROUND THE FIRE AREA WITH YOUR SHOVEL TO WET ANY REMAINING EMBERS AND ASH.
- FEEL THE AREA WITH THE BACK OF YOUR HAND TO ENSURE NOTHING IS STILL SMOLDERING.
- TURN WOOD AND COALS OVER AND WET ALL SIDES.
- MOVE SOME DIRT ONTO THE FIRE SITE AND MIX THOROUGHLY TO FULLY SMOTHER IT.

ONE LESS SPARK ONE LESS WILDFIRE

FOR MORE INFORMATION AND A PRINT-READY CAMPFIRE PERMIT VISIT:
PREVENTWILDFIRECA.ORG
#PREVENTWILDFIRE #ONELESSSPARK

BROUGHT TO YOU BY THE CALIFORNIA WILDLAND FIRE COORDINATING GROUP (CWCG)

PRACTICING VEHICLE SAFETY

Proper Vehicle Use to Prevent Wildfire

MOTORISTS ARE RESPONSIBLE FOR MANY OF THE WILDFIRES SPARKED ALONG OUR ROADWAYS. NEARLY ALL THESE FIRE STARTS COULD BE PREVENTED BY FOLLOWING THESE SAFETY RULES:

SECURE CHAINS

PRACTICE SAFE TOWING. DRAGGING CHAINS THROW SPARKS. USE APPROPRIATE SAFETY PINS AND HITCH BALL TO SECURE CHAINS.

NO DRAGGING PARTS

MAKE SURE YOUR VEHICLE IS PROPERLY MAINTAINED, WITH NOTHING DRAGGING ON THE GROUND.

CHECK TIRE PRESSURE

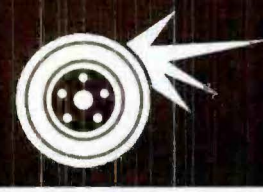
MAINTAIN PROPER TIRE PRESSURE. DRIVING ON EXPOSED WHEEL RIMS WILL THROW SPARKS.

CARRY A FIRE EXTINGUISHER IN YOUR VEHICLE AND LEARN HOW TO USE IT.

DON'T DRIVE YOUR VEHICLE ONTO DRY GRASS OR BRUSH. HOT EXHAUST PIPES AND MUFFLERS CAN START FIRES THAT YOU WON'T EVEN SEE—UNTIL IT'S TOO LATE!

PROPERLY MAINTAIN BRAKES

BRAKES WORN TOO THIN MAY CAUSE METAL TO METAL CONTACT, WHICH CAN CAUSE A SPARK.



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Mailing Articles: Send electronic files by email or traditional mail to:

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